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Engineers Report on Remarkable Failure of a Concrete Building at Salina, Kansas

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

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The Coming Victory

ON OCT. 5 the ballot on the constitution of the American Society of Civil Engineers will be canvassed. We thought that the debate on the subject was long since over, but the fight is still on. Witness the letters elsewhere in this issue. Two prominent revisionists oppose the proposed revision. What will be the next engagement in this long-drawn-out war? According to Mr. Humphrey the triumph of the revision will be a defeat for the society, and defeat of the revision a triumph for the old constitution, which he and his associates tried so hard to change. We are in the position of little Peterkin, and when the next skirmish is over on Oct. 5, we shall confusedly ask, "But what good has come of it at last?" We fear that some thousands of members of the society will answer, with Southey,

"Why that I cannot tell,
"But 'twas a famous victory."

Taking Ourselves Too Seriously

ALL THIS bickering in the American Society of Civil Engineers prompts the inquiry whether ever so many of us have not been entirely too serious about this whole business. We will admit that we ourselves have been. There was needed a goodly group to sit on the fence and plainly tell each side its shortcomings and laugh at the foolish points in its campaigning. The fence sometimes is not a bad place to be. For one thing the man sitting there would plainly see in this prolonged fight that the society is a thing bigger and higher than either of the groups temporarily in control or fighting for it. And seeing that, he could afford to smile. Setbacks there may be, but the virile strength of the society will eventually assert itself. Even in the most conservative days of a conservative past the society continued to grow and its prestige to increase.

At 60 per Cent Capacity

FREQUENT occasion has been taken in these columns to point out the present status, as regards activity, of the construction industry. We fully realize that it does not help the feelings of the man who has no work to know that the construction industry operated at 60 per cent of last year's capacity in the first half of this year, and is above that figure now. Nevertheless, it is a salutary thing, whether for better or for worse, to know where one's industry stands with reference to the other industrial activities of the country. In the case of the construction industry, we would say that the situation a present is "for better." The steel industry, for example, operated at 29 per cent capacity in August, the machine-tool industry at about 9 per cent, while the automobile industry was somewhere between 60 and 70 per cent. The figures of the construction industry certainly compare well with these, and particularly with the steel and machine-tool trades. On the other hand, there are industries that are doing much better. The cotton industry, for example, is operating at practically 100 per cent capacity, and the woolen industry at about 80 per cent. Given branches of the construction industry, too, are in better shape than the industry as a whole. The cement plants, as we know, are operating at practically last year's capacity. On the whole, the construction industry has reason for congratulation. As we have previously said, the margin between good times and bad—for the individual at least—is a very narrow one indeed. All of us have not been working, but, taken as a class we have been distinctly better off than our fellows engaged in other lines of endeavor.

Last Week's Wage Reduction

BY FAR the biggest piece of news last week on cost matters was contained in the Navy Department's wage reduction and the decision of Judge Landis, as umpire, on the Chicago building-trades wages. The Navy reductions, made after lengthy investigation, ranged between 13 and 14 per cent, while those in the Chicago case ranged from 10 to 33 per cent. More important, though, in the latter case is the abrogation of restrictive working agreements, which abrogation alone will reduce costs as much as would a 20 per cent wage reduction had other factors been held the same. Judge Landis' decision is of the same quality as the acts which have won him such a large following in the Middle West. The decision may be styled as that of "more than a judge." Instead of splitting hairs, in approved legal fashion, he goes to the core of the situation. With one stroke he breaks down the restrictions by which the employers of Chicago have kept out outsiders, and with another breaks down working agreements which he does not hesitate to characterize as having been created to give the parties a monopoly and to produce waste for the mere sake of waste. He calls a spade a spade, not in any bitterness but by baldly stating facts. At this writing some of the trades are appealing for a rehearing. It is to be hoped, however, that the force of public opinion will induce them to stand by their agreement to accept the umpire's award. The whole country will benefit by Judge Landis' work, however, even though the Chicago unions show themselves poor sports and refuse to accept the award.

Overlaps and Confusion

OVERLAPS in state departments are created as fast as or faster than they are removed. In our issue of Aug. 4 we outlined the transfer of certain engineering functions in New York state departments and questioned the wisdom of dividing responsibility for state control of the sanitary-engineering plans of cities into engineering and sanitation, so the duty of passing on certain municipal plans is vested in the state engineer's

office while the supervision of the operation of water supply and sewage-works is left with the health department. Scarcely has such legislation to amend the state health and conservation laws gone into effect when the Conservation Commission announces the organization of a Bureau for the Prevention of Stream Pollution. True, this is designed to protect fish and shellfish, but why should not everything pertaining to water pollution be vested in a single bureau of a single department instead of being scattered among three bureaus of three departments? With the new bureau in operation, sewage disposal in New York State will be under the control of the state engineer as regards plans for new work, under the health department as to the effect of operation on human life and under the conservation department as to fish life. Such scattering of responsibility makes for neither economy or efficiency.

Automatic Control

HYDRO-ELECTRIC plants are now being provided with many automatic features that tend to increase safety, economy or smooth operation and which were entirely unthought of a decade ago. The Kern River No. 3 plant built in California recently, in addition to being of interest as the highest-head turbine plant yet put in service, probably comes nearer being automatic, "fool-proof" and safe in emergencies than any other plant of its kind ever built in this country. In fact, automatic devices in this plant involve so much purely mechanical and electrical detail that the greater portion of its equipment is more properly in the fields of mechanical and electrical designers than of the civil engineer. What these devices are designed to do, rather than how they do it, is made the substance of a discussion of the automatic features of the Kern River No. 3 plant on another page. The notable success of automatic substations on electrical distribution systems has probably had a good deal to do with the tendency toward more and more dependence on automatic features in electrical generating plants. Of course, there is the disadvantage of having in such plants, and subject to derangement, all the additional equipment which these operations require, but on the whole with careful machine work, rugged construction and accurate adjustment in installation, this tendency to reduce the manual operation required of the generating-station operator is increasing safety and making for better and more dependable electrical service.

The Day of Visions

THIS is a workaday world and our task in working hours—unless engaged in research—keeps us down to the practical, immediate money-making affairs of life. When evening comes, though, there should be time for the mind to expand, to wander into fields of speculation, and to rise to new heights in things material as well as spiritual.

In the material way we may feel that the best is behind us and that the rate of acceleration in exploring the unknown will slacken. Have we not in one generation taken electricity as an infant and brought it to manhood with perfection in light, propulsion, and both wire and wireless communication? Have we not developed the self-propelled vehicle from nothing and to a convenience and tool of the masses? Moreover, in a few swift years, have come air flight, tremendous submarine progress, the discovery of new light rays and of the marvels of radio-activity, and the enunciation of the phenomena of relativity. It would seem that the pace must slacken.

Yet, is it not sounder to hold that the new plane to which we have been raised is but assurance of more successful and more rapid attack on the unknown? This thought comes home in reading the inspiring address of Arthur D. Little, of Boston, before the American Chemical Society last week. He sketches rapidly new fields that are beckoning and pictures mighty empires to be conquered. Not all he says is new, but its juxtaposition gives to the whole a great attraction. When will come the day when solar energy will take the place of our dwindling fuel supplies? "The world," he said, "awaits the genius who will convert radiant energy into electric current." The Sahara Desert receives solar energy equivalent daily to that of 6,000,000,000 tons of coal. Further, he intimates that the energy of the earth's rotation may some day be utilized. Sperry has used it with his gyroscopic compasses and stabilizers, and, if this be thought an insignificant use, Mr. Little reminds us of the day when the only known man-controlled electric phenomena was the picking up of a feather by a rubbed bit of amber. He mentions the tides as possible sources of power, and then enlarges upon the inconceivably great stores of atomic energy. These, he says, we now "recognize as of an altogether higher order of intensity and magnitude than the energy derived from burning coal or liberated from the most powerful explosives." That energy may some day be loosed and more than make up for our consumed fuel supply.

Verily, the day of our mastery of the unknown should not be past, nor should the pace slacken.

Ills of Excessive Mechanization

WHILE thinking of the visions that Mr. Little has painted, it is apropos to look at another phase of our attack on material problems, emphasized at the recent Cincinnati meeting of the American Bar Association by James M. Beck, the eminent New York attorney, now solicitor general of the United States. To the "excessive mechanization of human society" he lays the "economic catastrophe of 1921" (the industrial disruption due to stoppages of work and the lessening of efficiency), which, he believes, is far greater than the politico-military catastrophe of 1914. He holds that the large multiplication of human power by machines has tended to intoxicate man. The lust for power has obsessed him. He consumes the treasures of the earth faster than he produces them. He has multiplied feverishly the things he desired, but even more feverishly his wants. To gain these he has sought the congested centers of life and by uncounted thousands has become a machine tender. The accompanying minute subdivision of labor "has denied to many workers the true significance and physical benefit of labor." It has, too, destroyed the spirit of work. Life has become too easy.

Mr. Beck does not charge that engineers are responsible for this breakdown. His inquiry is entirely impersonal, but no matter how much the financiers and the owners of industry may be to blame, his address does fling a challenge to us, the engineers. If we are high priests of an order that, while tending to make

life more agreeable, is making it less worth while in its intellectual and spiritual attainments, we certainly should appreciate it and be co-workers—yes, even leaders—in working out the remedy. "To rekindle in man the love of work for work's sake and a spirit of discipline," would, Mr. Beck believes, do much to solve the problem, "for work," he adds, "is the greatest moral force in the world." In this direction some engineers and some industrial executives have been working, by various efforts to revive the spirit of craftsmanship and to show the worker his function in the great whole.

Whether Mr. Beck is unduly pessimistic, the individual will judge, but that all is not well is only too clear. Engineers have a special responsibility in working out a solution, for it is upon their work that the present industrial and social order is built. As engineers, they cannot alone attain the desired good results. As citizens, as men, they can influence those civic and spiritual forces which must be co-workers in the task.

Lesson of the Salina Failure

SO MUCH was wrong with the design and construction of the Masonic Temple at Salina which collapsed in July that it would be easy to pass the failure lightly by with the comment that there is no lesson to be learned from it. Everyone knows that successful concrete work requires a fairly close approach to perfection in the selection of materials, the design of the structure and the methods of erection. Neglect in any of these three elements is dangerous; neglect in all three is fatal. The consulting engineers' report, abstracted in this issue, clearly charges the triple neglect. There will be those, therefore, who will say that here is merely another case of the disregard of the elements of structural practice, lamentable of course, but in no way pointing any moral except the obvious one that one cannot violate fundamental principles.

To take this view would be to miss the main feature of the failure, that is the irregularity of the structural framing and the part it played in the collapse. Reinforced-concrete design has progressed most rapidly in the last decade not so much in the detailed designing and computation of the individual members as in the use to which these members are put. The theory of the beam, the column and the slab is under constant discussion and some revision but the effect has been mainly to raise somewhat the unit stresses allowed. Basic design is little different from that of the first Joint Committee report. In the size and framing of the units, however, there has been constant development. Whereas in the early days, in this country at least, the typical reinforced-concrete building was a box-like structure of regularly spaced and squarely placed short-span panels, there have been an ever increasing number of complicated structures with long span floors and roofs, cantilevers, trusses, eccentric columns and all the other irregularities of frame long common in structural steelwork. These complications impose a certain burden on the skill of the designer, but by no means as great a one as on the constructor, because of the fact that reinforced-concrete members are not self-supporting for some time after their placement and the structure during its erection period is in an entirely different state of loading and support than after it is put in service.

The fundamental error of the designers and builders of the Salina temple was that they did not recognize the obligations their elaborate framing imposed. Granting that the concrete was weak, though for what reason the engineers' report does not state, granting that the stresses for ultimate load were unduly high, the real reason for the collapse lay in the use of the reinforced-concrete trusses over the auditorium, trusses which were not even in when the building collapsed. The very fact that these trusses were adopted required that the entire load of the ceiling of the auditorium be carried, through 37 ft., to the floor below, another long-span construction itself carried to long-span beams below. A proper appreciation of the erection conditions imposed by this framing would have led not only to a thorough cross-bracing of the upper shores but to an investigation of the strength of the successive supporting girders and of the clay bottom on which the shores finally came to bearing.

Some thought evidently was given to the matter, or else the shores would not have been carried through at all, but the sin of omission lay in the disregard of the deflection possibilities in the long spans of the auditorium and banquet floors. Instead of the stiff, short spans and frequent columns of the ordinary concrete building, a condition that localizes possible failure during the setting period or throws the load on a capable column, there were flexible girders and joists which transmitted load and movement from floor to floor.

Certainly if the concrete of these lower members had been of proper strength or their design as to stiffness and stress been sufficient, the amazing progressive deflection described by the consulting engineers would not have taken place. Possibly, too, rigid shoring in the auditorium space might have saved the floor above. Neglect here, therefore, contributed to the failure. But the basic error was the attitude toward the structure in its entirety, the light regard in which were held the difficulties of a complicated reinforced-concrete framework. The necessities of good materials, adequate design and proper workmanship have been hammered over and over again. The Salina building may be added to the "awful examples" of what not to do in these respects, but more than that it should go on the records as a warning against too great confidence in the ability of reinforced concrete to stand abuse.

Incidental to the main lesson from the failure is the progressive deflection of the girders under a fixed load. This is a most unusual phenomenon and one on which more data should be given. The consulting engineers' report is much too categorical. Engineers would be better informed were they given the evidence that the bearing on the clay of the basement was insufficient to carry the load, that there were some indications of a punching of the mud sills into this clay, and that there were positive indications of the deflection of the girders under and over the banquet hall. The progressive deflection of five or six months' old concrete beams has been largely a matter of laboratory investigation. Some experimenters, notably F. R. MacMillan when he was working at the University of Minnesota, have noted this deformation under load, but the observation of such conditions in actual structures has been most rare and has never, we believe, been given as a cause of failure. The dangerous possibilities of plastic deformation have been much discussed in academic fashion Here is an opportunity for practical analysis and no data which would help such an analysis should be withheld.

Form Settlement Causes Concrete Building Collapse

Report on Salina, Kan., Masonic Temple States That Top Floor of Inadequate Design Failed Five Weeks After Pouring by Progressive Deflection of Lower Floors Carried to Foundation by Shores

ALTHOUGH adjudged structurally weak and built of materials giving a concrete of low compressive value, the primary cause of failure on July 11 of the Masonic Temple in Salina, Kan. (*Engineering News-Record*, July 28, 1921, p. 165), is stated to be the insufficient strength in the shores to prevent buckling and collapse when deflections due to settlement of shore foundations redistributed the loads and concentrated

FIG. 1. LOOKING WEST ACROSS SOUTH END OF BUILDING

them on certain points. These are the conclusions of the Condron Co., Chicago, engaged after the collapse as consulting engineers by the owners to investigate and report on the cause or causes of the failure. The failure is one of the most remarkable in the history of concrete because the upper story, where initial collapse occurred, was five weeks old and the lower floors, whose progressive deflection permitted the top floor to sag and fail, were from eight weeks to five months old. Furthermore, all of the later concrete had been placed and cured in temperatures far above freezing.

The Masonic Temple at Salina had an irregular layout of floor heights and beam spacing because of the inclusion of lodge room, banquet hall and auditorium. As shown in the accompanying drawings it was 123 x 169 ft. in plan and 90 ft. high, with six floor levels over part of the area, but with extra high stories at the special rooms noted. It was of reinforced-concrete frame, with practically all square rodded columns, beam-and-slab floors and a terra cotta and face-stone exterior. The columns carrying the roof trusses, noted hereinafter, were 30 to 36 in. square with 25 to 33 in. circular cores inside hoops with 2½ in. pitch.

In the straight story section the beams were 15 to 35 ft. span and framed square to the columns, but over the large rooms girders of spans above 40 ft. were used. The ceiling of the auditorium, which was the floor of the lodge room, was of the special design shown; that is a series of 41 ft. girders on 3 ft. centers framing into columns at their outer ends but into the lower chords of two heavy reinforced-concrete trusses at their inner ends.

At the time of the collapse the structural frame was complete with the exception of these large trusses and the roof, forms for which were partly in place. In consequence, the completed concrete floor of the lodge-room, which in the finished structure would have been supported on the lower chords by the trusses, was supported on shores extending to the auditorium floor, 37 ft. below, and this constrction load was further transmitted by a veritable forest of shores through each of the stories in turn to the lowest tier of shores which rested on mud-sills on the ground. The settlement of these lowest shores is given by the Condron Co. report as the primary cause of the failure. The main part of that report is given below, together with drawings prepared to accompany it.

On Fig. 7 will be noted two closely spaced lines of shores (2 ft. c. to c.) placed directly under the bottom chord sections of two 85-ft. reinforced-concrete trusses from which the lodge floor over the main auditorium was to be suspended. Under the remainder of the lodge floor the shores were uniformly spaced under the concrete ribs. Each of the closely spaced shores under the east chord supported 3,454 lb. dead load and those under the west chord, 2,954 lb. On each shore under the east portion the load was 2,159 lb. and on the shores supporting the west portion of the lodge floor it was somewhat less, 1,709 lb., because the roof form above had not yet been built.

The lodge floor concrete was five to six weeks old. On Figs. 5 and 6 it will be seen that part of the shores supporting the lodge floor rested on the long span construction of the central part of the auditorium floor, and that the remaining shores rested on more rigid short spans on the north and south sides and the east end of the auditorium floor. The shores under the second (auditorium) floor rested on the long span construction of the first (banquet) floor. Also under each of the long span girders of the

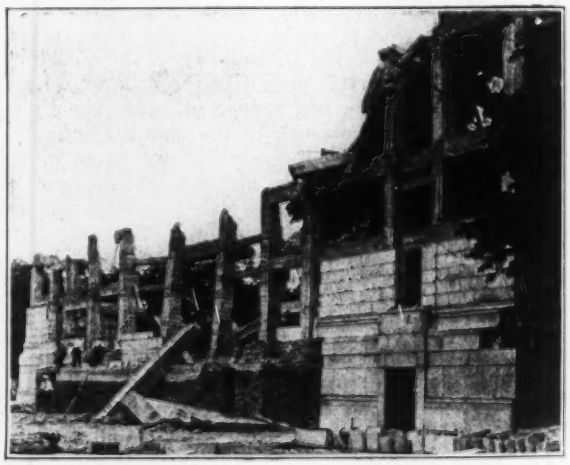


FIG. 2. VIEW OF ALMOST COMPLETE COLLAPSE AT REAR

first floor, were placed eleven shores which rested on the ground or on the floor of the duct trench.

The second or auditorium floor concrete was more than three months old while that of the first or banquet floor was poured in January and February. Shoring had been maintained continuously under all of these floors. The shoring under the lodge floor was about equally divided between 4 x 4-in. timber and 2 x 6-in. pieces teed.

Eye witnesses stated that there was some bending or buckling observed in the long shores in the east half of the auditorium space underneath the lodge floor about one

hour before the collapse took place. Carpenters were put to work renailing the braces on these shores and additional material was hurriedly ordered with which to reinforce and re-brace the shores which were showing signs of distress. It was also observed that some of the shores were loose and wedges were ordered to be driven between the tops of these loose shores and the ceiling of the auditorium. While this work was going on, one of the long shores toward the east end of the auditorium space broke under its load, and the carpenter foreman ordered all of his men out of the building. The breaking of this first shore was followed by the breaking of a number of other shores, and within a few moments, so much of the shoring gave way as to allow the lodge floor to fall, carrying down with it portions of the second or auditorium floor, the banquet balcony and the first or banquet floor.

A careful investigation of the wreck and a study of the plans disclose that the shores were of sufficient strength

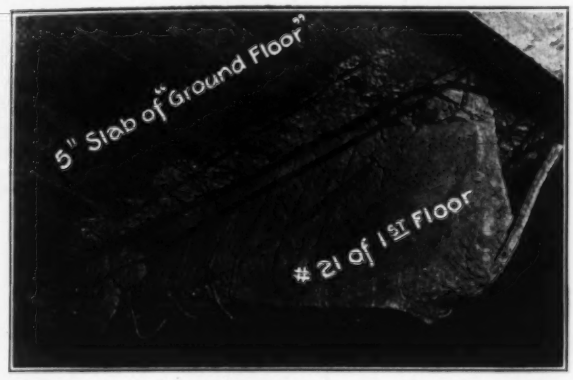


FIG. 3. FALLING BEAM BREAKS THROUGH 5-IN. SLAB

to support the dead weight of the lodge floor so long as it was uniformly distributed over the great number of shores on which it rested, and so long as these shores remained in straight or vertical positions; also that there must have been sufficient horizontal and diagonal bracing to hold these shores in position during the time that the concrete of the lodge floor was being poured and for several weeks thereafter. According to testimony, no shores, nor the bracing of the same in the east half of the auditorium space under the lodge floor had been removed or disturbed for at least two weeks prior to the accident.

Analysis of Failure—A large portion of the shoring supported on the auditorium floor rested on the long span joist construction of the auditorium floor which had a clear span of 43 ft. 10 in. It was relatively shallow and therefore would have deflected under load but for the closely spaced shoring below, which latter carried all of the load directly to the first floor (see Fig. 9). But for the additional shores under the first floor this load would have deflected the first floor long span girders. The loads from these shores were spread on the ground through 2 x 8-in. plank except the center shore of each girder which rested on the concrete slab of the trench floor.

Loads on the lodge floor were much greater than an auditorium floor would reasonably be designed to carry. Especially is this true with regard to the concentrated loads from the two lines of closely spaced shores under the truss chords shown on Fig. 8 as extending from column 46 to column 49 and from column 50 to column 53. However, the strength of this floor was not depended upon to carry these loads, but they were carried by shoring under the auditorium floor, resting on the first floor as shown in Fig. 9.

Loads thus delivered to the first floor were greater than a banquet room floor should reasonably be designed to carry. Here again the strength of this floor was not depended upon to carry these loads as eleven 6 x 6-in. shores or posts were placed under each of the first floor girders, consequently these eleven shores were depended upon to support practically all of the loads coming upon one of these long girders through the first floor.

The loads on these shores, particularly in the case of the girder 21 between columns 51 and 52 shown in Figs. 9 and 10 were so great as to cause compression of the ground and probable breaking of the trench floor slab, with the resulting deflection and overloading of this girder 21. According to the shoring plan two of the shores under each girder 21 were supported on the ground within 2 ft. of the 6-in. tile walls of the open trench, which was 4 ft. deep.

A reinforced-concrete slab or girder will deflect under load, and if the load is excessive, the deflection of the slab or girder will continually increase, either slowly or rapidly, depending upon the amount of stress in the steel and concrete and the strength of the steel and concrete to resist these stresses. In addition to the bending stresses, there will be shearing stresses which are the greatest where the slab or girder connects to its supports. Where excessive shearing stresses occur, diagonal cracks will appear near the connection of the girder to the supporting wall or column. It is reported that such shear cracks had been observed in these long girders 21 under the first floor. A reinforced-concrete slab or girder will fail slowly by fatigue under load which is not sufficiently great to cause immediate or sudden failure. Such progressive failure may require days or even weeks, provided the load is such as to stress the steel or concrete beyond its elastic strength.

The load delivered to the first floor was much greater than a safe load on girders 21, which had a span of 43 ft. 10 in., and so long as all or a large share of this load was carried to the ground by the shores under these girders, there would be slight deflections and corresponding low stresses in these girders, but as the shores pressed into the ground, these deflections and stresses would increase, thus greatly increasing the load on the center shore which rested on the thin concrete floor of the trench. It is therefore highly probable that the tunnel floor slab broke, resulting in a more or less gradual settling of this center shore and corresponding deflection of the girders 21, especially that girder supported by columns 51 and 52, directly under the east truss chord and its closely spaced shoring.

Referring to Fig. 9, it will be seen that there are five of these girders 21 which are located in the central region of the space occupied by the auditorium above. The area

FIG. 4. NOTE WAY LOWEST BEAM ON LEFT BROKE AWAY FROM COLUMN

of the auditorium ceiling is defined by the position of the four columns 20, 27, 69 and 77. The fourteen columns inside of this area shown on the first floor plan, extended from the ground to the floor of the auditorium, but did not extend above the floor of the auditorium. Therefore, the space in the central portion of the auditorium floor was not so rigidly supported as the space outside of and surrounding these fourteen columns. The second floor plan, Fig. 9 makes the above condition even more evident. The auditorium ceiling was of long span construction covering the area defined by columns 20, 27, 69 and 77, while only that

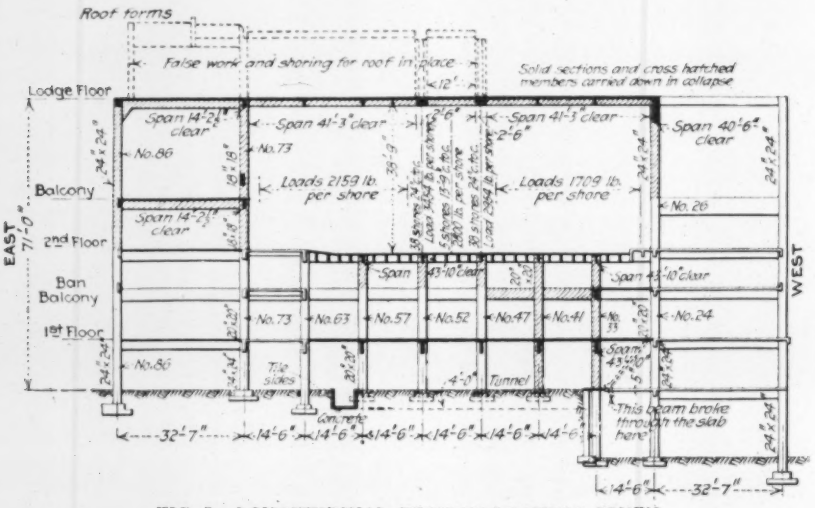


FIG. 5. LONGITUDINAL SECTION LOOKING SOUTH

portion of the auditorium floor defined by columns 23, 26, 64 and 61 was of long span construction.

But for the supporting power of the shores which rested on the ground, any part or all of this long-span floor construction shown on Fig. 8 would deflect much more than than the surrounding portion of the auditorium floor supported by the system or short girders; and with the deflection of the long-span construction, excessive loads would be brought upon the shores resting on the short span construction parts of this floor.

It will be seen from Fig. 7 that the long span joint of the lodge floor construction ran east and west and extended from the row of columns 69 to 77 to the east truss chord between columns 50 and 53, but that there was very rigid support under the east third of these joists, as well as under the north and south sections of this construction. Consequently, that portion at the east end of this joist construction between columns 60, 65, 69 and 77 was supported on shores having very solid foundations on the short span construction below. When the shores under the joist construction began to settle due to deflection of the auditorium floor and the first floor, the loads on the shores that rested on the short span construction were greatly increased, because these shores would remain rigidly supported. As a consequence, the shores that were rigidly supported above columns 61, 62, 63 and 64 became overloaded and began to buckle or bend. The connecting horizontal bracing between the shores would pull other shores out of line, thus increasing the trouble and finally some of these overloaded shores would break, thus precipitating the entire collapse.

Analyses of Structural Design.—Stresses in typical slabs, joists and girders of the first, second and lodge floors as shown in the table are greatly in excess of the safe working stresses allowed by city ordinances for ordinary practice. Tests indicate that the concrete in the slabs, joists and girders did not have an ultimate compression strength exceeding 1,000 lb. per sq.in. The calculated stresses are based on the actual computed dead load of concrete and a top finish 1¾ in. thick, a suspended ceiling and plaster or plaster on concrete, together with a live-load of 100 lb. per square foot of floor on slabs and joists or a live-load of 85 lb. for main girders.

Tests made at the Kansas City Testing Laboratory of a 6-in. cube cut from concrete from the building [at least

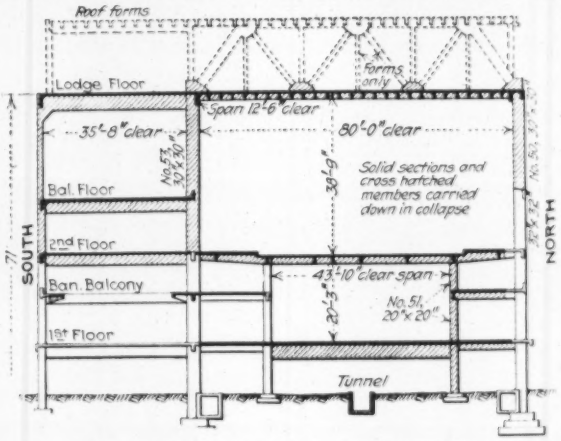


FIG. 6. CROSS-SECTION LOOKING WEST

40 days old] gave a compression stress of 921 lb. per sq in. With samples of material used on the building made up of 1:2:4 mix in this laboratory, compression tests of 6 x 12-in. cylinders were as follows:

Water Content, per Cent	7 Days per Sq.In.	28 Days per Sq.In.
8	1,113	1,622
10	917	1,304
12*	677	875
14	294	443

*Presumably the lowest per cent of water used in the field.

The concrete in the building shows every evidence of having been well mixed and placed. The stone used, however, appears to be soft and probably the strength of the concrete was limited by the strength of the stone. With an ultimate stress of 1,000 lb., the maximum safe working stress would not exceed 400 lb. In such concrete the maximum [safe—Ed.] shearing stress as a measure of diagonal tension in beams when fully reinforced, would not exceed 60 lb.

As that portion of the building which collapsed was supported on falsework up to the time of the collapse, and

CALCULATED STRESSES IN SLABS, JOISTS, BEAMS AND GIRDERS

Members	Concrete Section, In.	Steel, Sq.In.	Total Lb. Load per Lin.Ft.	Span, Ft.	Moment Coefficient	Unit Stresses Lb. per Sq.In. Steel	Concrete*	Shear
First Floor of Banquet Room								
Slab	5	0.392 per ft.	193 per sq.ft.	13½	1/12	22,500	885	...
Girder 62†	9x30	4.761	2,770	29½	1/8	30,800	560	172
Girder 11	9x30	1.870	1,602	16½	1/8	36,000	650	275
			64,200 lb. from Bm. 61					
Girder 21	10x42	7.53	3,045	45½	1/10	26,400	500	176
Girder 15	9x24	1.57 top 1.87 bot.	3,900	18½	**	32,000	750	180
Second Floor or Auditorium								
Joist	6x7½ x24	2.56	651	45½	1/8	34,000	940	115
Girder 62†	9x30	4.761	1,580	21½	1/8	30,800	560	172
Girder 11	9x36							106
Girder 15	9x24	5.57	2,715	18½	1/12	25,000	450	420
Beam 70	9x22	2.785	1,629	15	1/8	27,000	450	260
Girder 20	9x36	5.66	2,920	37	1/10	21,500	380	180
Girder 22	9x36	5.77	9,820	21	1/12	13,650	250	178
			*4,200 lb. conc.					
Lodge Floor								
Joist	6 to 7½ x24	2.56	651	45½	1/8	34,000	940	115
Girder 11½	14x66	12.48	5,105	40½	1/12	18,900	85	200
Girder 20	10x48	5.66	2,873	37	1/10	18,400	340	420
Girder 28	10x48	3.14	6,101	12	1/12	48,500	650	84

* These stresses are at the center of the beam where they are restricted by the concrete slabs. The compression stresses at the supports would be even higher.
** Beam figured as continuous. Loads on each of adjacent spans.
†Girder 62 extends between col. 24 and outer wall.

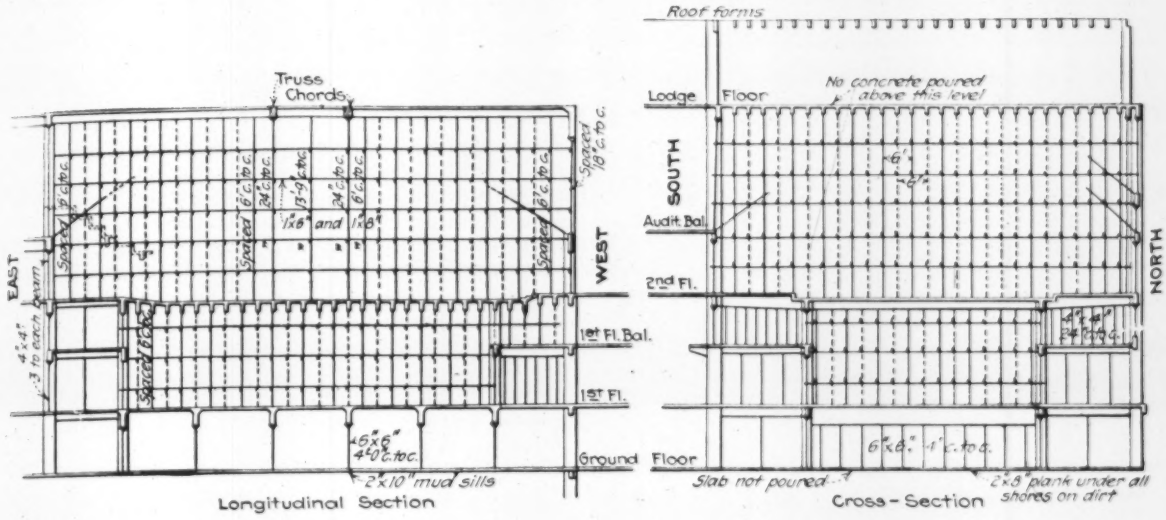


FIG. 7. SECTIONS INDICATING LOCATION OF SHORES ACCORDING TO CONTRACTOR'S DRAWINGS

Longitudinal and diagonal bracing butting against columns, beams, lintels and slabs 2 x 6 in. Other cross-bracing—1 x 6 in. and 1 x 8 in., about 50 per cent of each. Shoring under lodge floor—4 x 4's and two 2 x 6's Teed, about 50 per cent of each. Longitudinal and diagonal bracing butts against concrete members where possible. About 50 pieces 1 x 6 in. x 14 ft. used for diagonal bracing at random through shoring in addition to that shown on sketch.

as the two reinforced-concrete trusses designed to support the central portion of the lodge floor had not been built, this lodge floor could only have been supported by falsework up to the time of the collapse, or until these reinforced-concrete trusses had been completed long enough to have developed their full structural strength; consequently, the structural strength of the lodge floor as designed was not a factor in the collapse. The loads

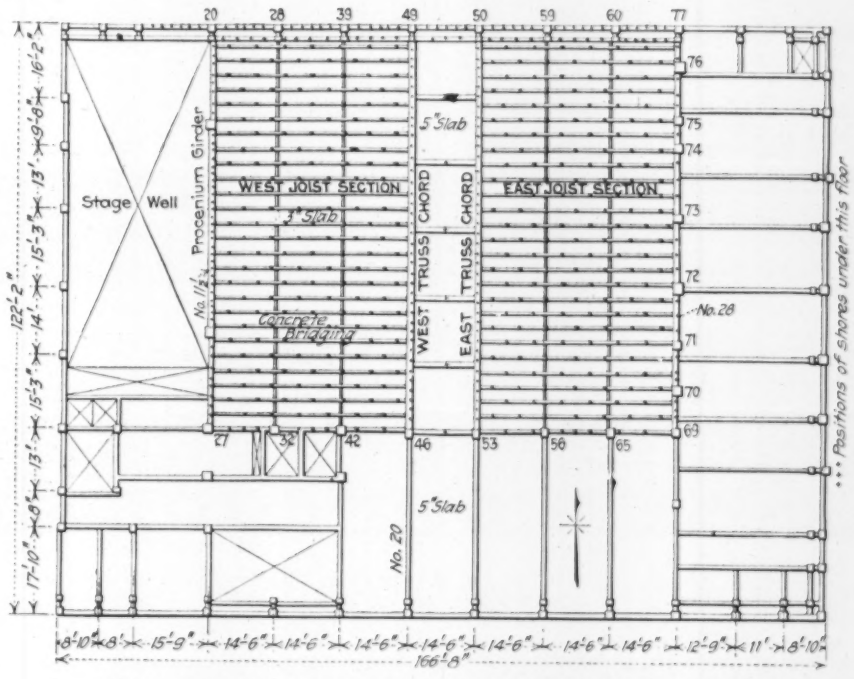


FIG. 8. LODGE FLOOR SHOWING LOCATION OF SHORES BENEATH

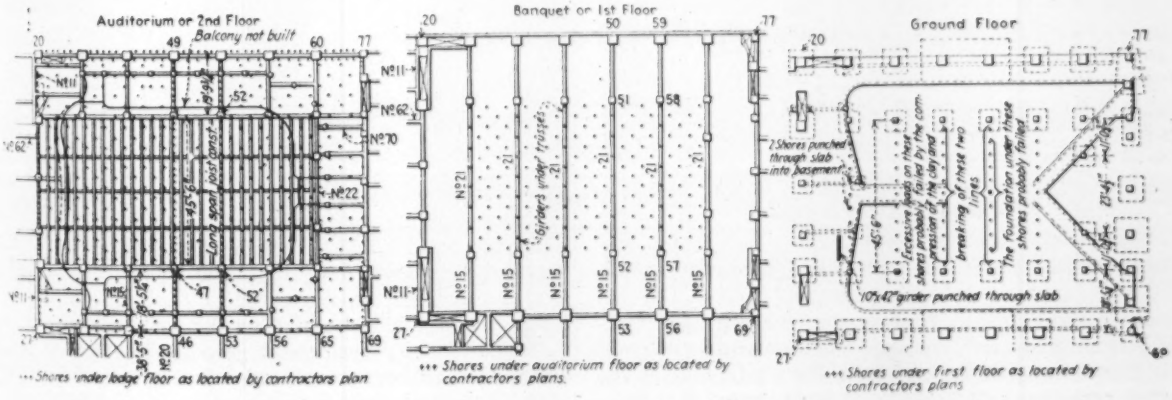

Auditorium or 2nd Floor
Balcony not built
*** Shores under lodge floor as located by contractors plan
Banquet or 1st Floor
*** Shores under auditorium floor as located by contractors plans.
Ground Floor
2 Shores punched through slab into basement
10"x47" girder punched through slab
*** Shores under first floor as located by contractors plans.

FIG. 9. LOCATION OF SHORES ON SECOND, FIRST AND GROUND FLOORS

from the shores supporting the lodge floor were greater than a floor for an auditorium would be designed to carry. Shoring was in place under this auditorium floor, and therefore, the structural strength of the auditorium floor was not a factor in the collapse. The load brought upon the first floor by the shoring which rested thereon, was a greater than a banquet room floor would be designed to carry, and this floor had sufficient shoring under it to carry its load, provided the foundations under the shoring were unyielding. With the settlement of the ground under these shores, the first floor construction was of entirely inadequate strength to carry this load.

If the girders of this floor had been well designed for 100 lb. per sq.ft. of floor surface as required by the Chicago Building Code, the load coming to this floor by the falsework, which amounted to as much as 265 lb. per sq.ft., would possibly have caused failure of these girders, provided there was no shoring beneath them.

According to our computations, the maximum safe load in addition to the actual weight of the floor construction on these girders would be 25 lb. per sq.ft., provided the concrete had an ultimate compressive strength of not less than 2,000 lb. per sq.in., consequently, these girders could not be relied upon to carry the construction loads without adequate shoring.

Conclusions — From our investigation of all the facts and of the conditions attending the collapse of this building, we are of the opinion that the collapse was due to failure of the falsework; that the falsework was deficient in diagonal bracing; and that proper provision was not made for supporting the heavy concentrations of load from the bottom chord sections of the proposed trusses.

The failure of the falsework probably began with the failure or settlement of the foundations under those shores that supported the long girders of the banquet room floor and that rested upon plank mud sills on top of the soil, except that the center shore under each of these long girders was supported on the trench floor. With the probable settlement of these shores, the long girders under the banquet room floor and the long joist construction of the auditorium floor directly above deflected; thus causing a redistribution of the weight of the lodge floor construction upon the shoring supporting the same. As a consequence of such deflection and redistribution of loading, the high shoring near the east end of the east section of the auditorium and adjacent to columns 62 and 63 would, because of its more rigid support in this region, become so overloaded as to fail, and the testimony shows it did fail, thus precipitating the entire collapse.

From our investigation of the structural design of this building, it is our opinion that this design is fundamentally inadequate in strength for a building of its character. It is our opinion that it is not possible economically to reinforce and strengthen that portion of the building which remains standing to make it adequately strong for even a building of this character, especially in view of the serious deflections and cracks that have developed in the beams and slabs which were not involved in the collapse.

According to information given out at the time of the failure the building was designed by William T. Schmitt and Valentyne Welman, architects, of Oklahoma City, Okla., and was being built in accordance with their plans and specifications, and under their direct and delegated supervision, by the Eberhardt Construction Co., of Salina.

The Road Tax in England

The gross revenue from the duties on motor and other vehicles in England for the five months ending May 31, 1921, is approximately £8,740,000. Of this amount £8,040,000 is from annual licenses and £700,000 from quarterly licenses. The actual amount paid to the highway authorities from the road fund for the same period was £2,863,243. It is estimated that £11,000,000 will be paid out in the year 1921.

British Housing Nationalization an Expensive Failure

(*London Correspondence*)

THE housing policy of the British Government was an experiment in nationalization, which everyone with experience felt would be an expensive failure. The decision of the government to suspend the financial assistance which has been extended to local authorities in housing was not unexpected by those connected with the trade. The method which was adopted of giving direct contracts for building houses in large numbers to contractors was an expensive and wasteful system. Under this system the loss has been very heavy, and will probably be in excess of £1,000 on each house built. On the 176,000 houses undertaken the loss would thus amount to £176,000,000. This figure does not include cost of administration incurred by the Ministry of Health, the Housing Commissioners and the local authorities, nor does it provide for road making or legal and professional costs. These items will materially increase the total loss and it is reasonable to assume that the final actual loss to the taxpayer will not fall short of £200,000,000.

The 176,000 houses which are to be built by the government contract, and which will take several years to complete, equal only two years' normal requirements for new houses, without making provision for the replacement of old and worn-out dwellings. The total efforts of the government, therefore, [on being brought to an end] will leave the shortage greater than ever.

In the period of restricted rents and high prices when there was no market for the sale of houses as an investment, the house builder could not build as a commercial venture, and some tentative efforts were made to assist private enterprise by the grant of a subsidy toward the inevitable loss. The government has announced that the subsidy scheme will also be withdrawn, and that no grant will be paid on houses not commenced before July 1. It was estimated by the Minister of Health that about 23,000 houses would be built under this scheme. The maximum loss to the taxpayer on the subsidy houses is £260 per house, and it is noteworthy that subsidy houses have been built at a greater rate than contract houses. The government had promised that the subsidy scheme should be continued; it had set aside a sum of £15,000,000 for this special purpose, and passed an Act of Parliament extending the time for the building of subsidized houses to June, 1922. On the strength of these promises builders have purchased land and materials, and have plans and schemes in hand for many thousands of houses.

The effect of the new policy will be to hold up all house building for a time until the rent of the house is enough to pay for the cost of building. In view of the gradual fall in prices the subsidy scheme was bringing economic housing within measurable distance, and was encouraging the builder to construct with some prospect of an adequate return on his outlay.

The sites which will have to be discarded would have provided for about 10,000 to 12,000 houses, and where local authorities cannot dispose of these on favorable terms, the loss will be met from the government grant.

In addition the government proposes to spend £200,000 a year on improving houses in slum areas rather than on pulling down whole areas and attempting to rebuild them.

Impressions Here and There

New Orleans—Where Engineers Have Labored and Built Well

NEW ORLEANS as a human city reflects the hospitality of the South, the open-hearted freedom of the West, the culture of New England and to a certain extent the matter-of-factness of the Middle West. Withal, first impressions are decidedly mixed. An excursion by boat around the crescent of the river past the extension harbor improvements could not fail to bring comparisons with New York. But, as has been said before, other ports have the facilities, but New York does the business. So New Orleans has dock facilities aplenty of every kind. But it takes more than facilities to make business. The whole Middle West should, geographically speaking, be sending its farm produce to Europe, to South America and to the Far East, via New Orleans and other Gulf ports. All the facilities are there, engineers have done their part, but custom and rail routes run east and west. Manufacturers have their foreign departments at the eastern seaboard. South American boat schedules and accommodations to New Orleans are second class. Trade follows the passenger business. The Middle West and New Orleans are detached despite the strenuous efforts of the Mississippi Valley Association to bring port, product and shipper together. Nevertheless an enormous raw products business does pour outward through the southern seaport and it is constantly increasing in volume, particularly in grain and manufactured products to the Far East through the Panama Canal.

Inner Harbor a White Elephant

Probably the two features in New Orleans of most interest to one of engineering bent is the enormous Inner Harbor lock and canal and the drainage works by which the city keeps itself from inundation. In some circles the Inner Harbor is looked upon as a white elephant. Initially projected to cost perhaps $1,500,000 it has been elaborated upon until it rivals the Panama locks. War time costs have pushed the estimates continually higher until considerably more than $20,000,000 will be involved before the project is completed. Building foundations on the uncertain soils of the Mississippi delta country is expensive. And as one engineer remarked "now we have it, what are we going to do with it."

A few of the shipyards and maritime manufacturers who courageously settled on the Inner Harbor canal and launched their craft through the Lake Pontchartrain end are not going to be extremely busy for some time to come. No one is busy on new cotton warehouses. Certain manufacturing establishments can utilize negro labor and may be induced to settle along the canal but custom is going to operate in favor of the present facilities regardless of the variation in river heights for many years. Five years ago Chicago built a $5,000,000 municipal pier on its lake front and tempted without success the steamboat owners out of the narrow, swift current of the Chicago River. Steamers still ply the river and the pier is idle except for its dance pavillion at the end and Pageant of Progress exposition. So New Orleans is having apprehensions of the difficulties of allocating industries where the engineer has made provision for them.

Interwoven with this problem is the age-old one in New Orleans of the abandonment of the Mississippi River outlet for a slack water non-silting channel via one of the lakes. In the improvement of the lower parts of the river and in the creation and maintenance of a deep water outlet to the sea, they have had the advice, the assistance and the direction of some of the ablest engineers of the world, the backing of the wealthiest of nations and the intelligent co-operation of some of the most competent contractors' organizations ever engaged in similar works. These have all contributed in making of New Orleans a great world port and have maintained a channel to the sea which will accommodate *nearly* every class of vessel now afloat and have been able to keep this channel open for commerce *most* of the time.

No one better appreciates, however, the true conditions down at the "neck of the bottle" than those who have contributed their talents and their time in the maintenance of this channel. It is in no way a criticism of the work which has been done by these men when it is stated, according to one of the city's prominent engineers, that nothing yet has been done which promises to insure an absolutely safe, dependable and permanent route from the Head to Passes to deep water, or to recall that the history of navigation of these waters contains repeated accounts of vessels carried suddenly out of their course, great ships stranded on mud flats and occasional collisions in the restricted channel. The limit of capacity of the main shipping outlet (that at South Pass) has nearly been reached and the results secured from recent attempts to create and maintain a channel through Southwest Pass have not been entirely reassuring. The slack water plan contains no experiments in untried fields of engineering and it would avoid the silt complications and shorten the distance of travel for a large proportion of vessels. But desirable as this proposal may be from the engineering standpoint there are powerful interests, of which the organization of those who pilot boats in and out is not the least, that will make any change a decidedly hard one, politically, to accomplish.

The Drainage System

Truly the drainage problem of New Orleans is a marvelous and striking exposition of the engineer's ability to make habitable, sanitary and safe a vast municipal area. George G. Earl, of course, is the engineer to whom one naturally goes for information on the three most essential public utilities in New Orleans, for he is superintendent and general manager of water, sewerage and drainage. All of them have cost $32,000,000 or $400 for each of the 80,000 premises served, $130 for water, $110 for sewerage and the remainder for the drainage system. The tendency toward decreasing density of population due to the widely scattered building in new areas is being watched with anxiety for the Sewerage and Water Board has but one source of construction funds for extension, a fixed rate of tax on assessed valuations. At that Mr. Earl claims that the municipal per capita revenue of New Orleans is by far the lowest of any city in the United States, having a population of 300,000 or more.

The general basis on which the original system was laid out did not contemplate caring for maximum downpours because the people would not pay for such drainage equipment. New Orleans gets occasional rainfalls

ranging from rates producing in 30 min. 5½ cu.ft. per second per acre to a 12-hour rainfall average of 0.75 cu.ft. The maximum rainfall of the average year will show about one-half of these rates and the ability to remove these average year maximums is about the limit to which Mr. Earl feels it is, at present, desirable or practical to develop the run-off capacity of the main drainage system. However, the 8,900 sec.-ft. capacity, which the original Drainage Advisory Board considered would be the final capacity within 50 years is nearly reached with the present capacity of 8,000 sec.ft.

So much for inside data. Out on the physical plant one is impressed with several novel features. Pavement cracks are unusually prevalent, curbs are out of alignment, and A. B. Wood, Mr. Earl's mechanical engineer, tells us the water pipes and sewers are forever breaking due to the settlement and shrinkage. Settlement of 3 to 4 ft. after 4 or 5 years of cultivation is common in the tidal level areas where levees have been built and the surfaces drained. Contrary to ordinary practice, ramming local clay back-filling beyond a certain point is useless and so is flooding, because the clay volume varies with the water content, the more water the larger the volume, which only increases subsequent shrinkage.

Automatic Pumping Stations

The automatic electrically-operated underground pumping stations for sewage with kiosk openings onto the street need mention, for many of them have been in service more than 5 years without opening the pumps or other repair. One hardly could realize that automatic float valve electrical control could be so foolproof but the rugged character of the mechanism bore testimony to the fact that the designer preferred to pay interest on investment rather than high upkeep. This "hell-for-strong" idea is everywhere in evidence. Perhaps the most unique experience is to lower one's self into the core of one of the largest drainage pumps and within this hollow-egg-shaped support for the inner bearing of the 1,200-sec.-ft. screw pump hear Mr. Wood tell of the pump's performance. No repair wrenches have yet broken the gloss of the original paint applied five years ago when the pump was installed. "The original oil is still in use and no bearings ever run warm" says Mr. Wood.

When the New Orleans rapid sand filters were put into successful operation 12 years ago sanitary engineers felt assured that no water existed which could not be handled. They were doubly elated because many years previously the attempts to filter the river water had signally failed and with that failure carried to bankruptcy the water company. New Orleans gets good water now. The chemical treatment is lime and iron which, as everywhere, incrusts the filter sand. Here it has solidified also the gravel support and John Porter, superintendent, in overhauling one of the filters was drilling out the cemented gravel with bull points. However, said John, the $1,200 cost spread over 12 years only amounts to 9c. per million, which is not prohibitive.

All in all one gets the impression that engineers in New Orleans have done a big work for the city. In fact but for him and his work there would be no city of consequence there. Much yet remains to be done but it is not of the former spectacular type.

One cannot refrain from commending the Sewerage and Water Board for maintaining the continuity of its engineering staff. As Mr. Earl says, the nucleus of this splendid organization developed through 25 years still is retained. Not a single employee has lost his position by reason of political consideration. Because of the loyalty of the board to the men in making promotions from within the service and of expecting and permitting its employees to exercise the character of initiative a spirit of reciprocal loyalty has been developed, which gives to worth-while men such an interest in their work that they will sacrifice much of personal advantage rather than abandon it.

July 15, 1921. W. W. DeB.

Tests of Small Eyebar Heads for Airplane Lugs

SEVERAL series of tests to develop the best proportions of plate lugs or eye links for airplane brace connections have been made at McCook Field, Dayton, Ohio, for the U. S. Army. The eye ends of these lugs are closely similar to the heads of eyebars used in bridges, and the conclusions drawn from the tests are of interest in connection with practice in proportioning large eyebar heads, as discussed by Josef Beke in *Engineering News-Record*, Aug. 11, 1921, p. 234. The lugs tested ranged in capacity from 1,600 to 20,000 lb. The following note on the test results is taken from a summary report on the subject by B. C. Boulton, of the Airplane Section, Engineering Division of the Air Service, U. S. Army.

Some of the lugs tested had "concentric" heads, that is, circular heads with pinholes in the center of the head. Other heads were "offset," the semicircular end of the head having its center beyond the pin center. The concentric heads broke generally at a section whose original position made an angle of 45 deg. with a diameter through the center of the pin hole. Tests of lugs with "offset" of $\frac{1}{32}$ to $\frac{1}{16}$ in., showed that by thus increasing the diagonal area through the eye it was possible to develop the full strength of the metal in tension at the minimum section, i.e., at the sides of the holes. The general range of eccentricity being established, any lug could be designed and its strength computed directly, because failure, if in the head, occurs on a section through the eye at right angles to the axis of the bar at a stress equal to the tensile strength of the material. Results found with dead annealed, cold-rolled and heat-treated steel, either carbon or alloy, were similar.

The lug designs that were worked out as the result of these tests were based on making the area through the head at the back of the pin hole (in the line of the axis of the bar) from 30 to 40 per cent greater than the section through the sides of the pin hole. The larger sizes of lugs were given the greater excess area, "since the portion of the stress around the eye due to bending increases at something less than the square of the pin diameter." The offset from $\frac{1}{64}$ in. in the smallest size of lug to $\frac{1}{16}$ in. In the series of designs, with bars ranging from $\frac{1}{16}$ x $\frac{3}{32}$ in. to $1\frac{1}{32}$ x $\frac{3}{4}$ in., the pin diameter varies from $\frac{3}{8}$ in. to $\frac{1}{2}$ in., being 50 to 60 per cent of the bar width. The cross-section through the head at right angles to the axis of the bar has an area slightly less than the cross-section of the bar; but this latter is designed with an excess of strength of 20 to 25 per cent, to allow for additional stress arising from the fact that the bar (shank of the lug) is usually

belt. The section through the side of the head therefore represents an excess of 15 to 20 per cent over the bar strength.

With respect to pin diameter, the tests showed that bearing stress was never a contributing cause of failure, as the lugs in which the bearing stress did not exceed twice the tensile stress in the bar indicated no failure in compression at the back of the pin hole; even where there was a slight piling up of the material at this point in the test, the grains of the metal, examined by a microscope, gave no indication of the excessive compression. It was concluded that a 100 per cent excess of bearing stress over tension is a safe maximum for airplane lug design. The calculated shearing stress in the pin under full load was found to range from 21,000 lb. per sq.in. for the smallest lug to 51,000 for the largest.

Check tests of lugs according to the design just indicated showed breaking strengths substantially equal to the tensile strength of the material in every case (2 or 3 specimens of each size tested). Practically all the specimens failed in tension on a section through the center of the eye. It was found in these tests also that the bearing pressure on the pin can be increased for the thicker material, the heavier eye being stiffer on account of the mass of material which resists the tendency to a closing in of the pin hole on the sides of the pin.

The Blue River Sewerage Problem, Kansas City, Mo.

THE Blue River (drainage area 265 sq.mi.), which extends along the easterly limits of Kansas City, Mo., and flows north into the Missouri River, has become little more than an open sewer in dry weather. About 58 per cent of the area and about 50 per cent of the population of Kansas City is tributary. The sewage of the Blue River Valley together with the sewage of the entire metropolitan area discharges into the Missouri River which a few miles below is used as a source of water supply by the city of Independence, Mo. The problem of the Blue River sewerage project therefore includes an intercepting sewer and sewage treatment. The intercepting sewer is needed to relieve the Blue River of its present objectionable sewage pollution. There is involved primarily the capacity of the intercepting sewer and the probable development and use of the Blue River. Affecting this part of the problem are considerations of population, park development, rainfall, run-off, existing sewerage works, probable construction costs and sewage quantities. Affecting the sewage treatment parts of the problem are considerations of the rates of flow in the Missouri River, the population on the drainage area, the uses of river water and probable construction costs.

A report with recommendations has recently been submitted to the Board of Public Works of Kansas City, for which Robert W. Waddell is engineer and Paul A. Hartung is engineer of sewers, by Pearse, Greeley & Hansen, consulting engineers, Chicago. A bond election is set for this month. The problem has been studied for many years by the Sewer Department and much information was available. Following a thorough discussion of intercepting sewer practice (see table) are the following recommendations for the intercepting sewer:

1. Where possible, separate sewers should be provided in districts as yet undeveloped.

2. Where the intercepting sewer is planned to prevent the pollution of park ponds or lagoons, a capacity of 400 gal. per capita daily, equivalent to only four dilutions, is not too low for Kansas City conditions. For such relatively intense developments a flow at the rate of 500 gal. per capita daily of tributary population would not be unreasonable.

3. For portions of the intercepting sewer designed to protect a flowing stream passing through industrial districts, a capacity for not less than about 200 gal. per capita daily would relieve the stream sufficiently to prevent the too frequent occurrence of objectionable conditions of relatively long duration.

4. It is not unreasonable to plan sewer capacities at the above per capita rates of flow for a population of 25 per acre from the tributary areas.

5. The estimated construction cost of the intercepting sewer on this basis is around $2,000,000.

6. Should the capacity of the Blue River intercepting sewer, as built, prove too small at a later date to afford sufficient protection to Blue River, as developed, it would be feasible to install at the principal overflows treatment plants for the storm sewage and thus provide a further protection to the water course. This treatment can be first by sedimentation and later by filtration should that be found necessary.

DESIGN DATA ON INTERCEPTING SEWERS

City	Gallons per Capita Daily — Ave. Flow Dry Weather	Gallons per Capita Daily — Intercepting Sewer Design	Gallons per Capita Daily — Ave. Water Consumption	Population per Acre Intercepting Sewer Design
Rochester	120	420	109	30
Detroit	155	329	152	42
Syracuse	160	375	152	35
Toledo	178	295	185	20
Milwaukee	150	364	120	23
Louisville	146	290	106	
Cincinnati	175	366	131	30
Desplaines	125	250	120	20
Cleveland	135	405	120	25
Albany	200	450	224	16
Fitchburg	75	445	93	10
Kansas City:				
Ludlow	100	520	125	25
Hartung	100	193	125	26.7

In the discussion of the problem of sewage treatment along the Missouri River there is indicated a total pollution for the Kansas City metropolitan area of 465,000 population and an additional pollution from industrial sources of 430,000 more equivalent population. The following recommendations were made:

1. From the standpoint of sewage pollution and stream flow, the river below the city has not yet reached a condition of nuisance requiring the installation of sewage treatment. On a low flow of 10,470 sec.-ft., which is available 98 per cent of the time, the dilution of the domestic and industrial sewage is equivalent at present to 11.8 sec.-ft. per 1,000 population.

2. The normal growth of population and industry along the Missouri River and the present available data relating to the condition of the river water point to the need for a comprehensive policy as regards sewage treatment and water supply. A comprehensive survey of the Missouri River through Kansas, Nebraska, Missouri and Iowa should be made to determine the conditions and lay down a definite basis of co-ordination of effort in lines of water purification and sewage treatment.

3. At the present time, therefore, extensive or complete sewage treatment is not considered necessary for the Blue River sewage. However, in our opinion, partial sewage treatment by rough clarfication with chlorination will be needed in the near future for Kansas City sewage. It seems to us reasonable, therefore, to make a start on sewage treatment in a moderate way at the present time in order to determine the working of a sewage treatment plant with Kansas City sewage. This conclusion in favor of moderate sewage treatment at the present time is further reinforced by the protection it will afford to the Independence intake, particularly during times of epidemic, and also by the prevention of deposits of sludge in the lower Blue River.

Oklahoma Engine Terminal and Line Revision; M., K. & T. Ry.

Extensive Improvements Cover Terminal and Freight Facilities and New Entrance to City—Novel Turntable—Coal, Ash and Water Softening Plants

AS PART of a program for remodeling and enlarging engine terminals, in order to provide for increasing traffic and the introduction of heavier locomotives, the Missouri, Kansas & Texas Ry. has recently completed a new engine terminal at Oklahoma City, Okla., at a cost of approximately $1,000,000. This new terminal includes a ten-stall roundhouse with machine shop annex, 100-ft. turntable with special end supports, 300-ton coaling station, power-operated ashpits, water softening plant, storehouse and minor buildings as well as tracks and facilities for freight car repairs and for cleaning and storing passenger cars. About thirty locomotives are handled daily at this point.

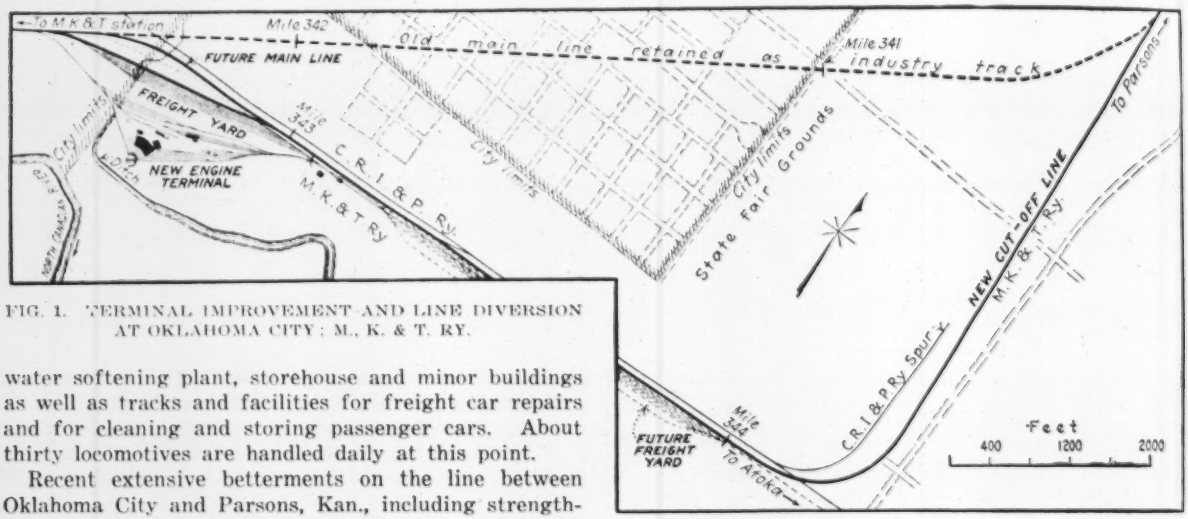


FIG. 1. TERMINAL IMPROVEMENT AND LINE DIVERSION AT OKLAHOMA CITY: M., K. & T. RY.

Recent extensive betterments on the line between Oklahoma City and Parsons, Kan., including strengthening of trestles, reballasting and heavier rails, have made it possible to operate larger and more powerful engines on this division. The old engine terminal, built in 1903, was inadequate for the equipment now in use, but the site afforded no space for expansion and it was decided to construct an entirely new plant at a location where ground is available not only for immediate requirements but also for future growth. A new main line approach was included in the improvements, as shown by the general plan, Fig. 1.

Relocation of Main Line Approach

To improve the approach to the new engine terminal and freight yard and also to improve the main line entrance to the city by eliminating ten street crossings at grade, a 2½-mile cutoff has been built, as shown in Fig. 1. The passenger station is at the end of a stub track connected to two main lines running north and east, the old main line from the north traversing a district laid out of residential development. To avoid this district the cutoff leaves one line north of the city and connects with the other at a point east of the engine terminal, as shown. A three-span concrete viaduct carries 23rd St. over the cutoff and 10th St. is carried under it by a concrete subway. There is a grade crossing of the Rock Island Lines, but all main track movements through the yard are protected by automatic block signals.

In the new engine terminal, Fig. 2, the track plan forms a flat triangular layout with direct connection to the turntable from each end of the yard. In anticipation of future yard extension, the plans for which include a new train yard east of the present yard (see Fig. 1), the main approach is from the east, three engine tracks leading from the throat of the yard to the turntable. Two of these are served by ashpits and two by the coaling station, while water columns serve these three tracks and also the fourth approach track at the west end, which is mainly for the use of passenger engines, the station being west of the engine terminal. Two stub tracks serve the ashpits and the coaling station. Along the north side of the layout is a thoroughfare or running track connecting the two approaches. The roundhouse is served only by the turntable, no through track or rear entrance being provided. Adjacent to it are five open radial tracks, without repair pits, for holding engines which do not need attention. These tracks are equipped with steam blower pipes for the engine fires.

Since the site included swampy ground a consider-

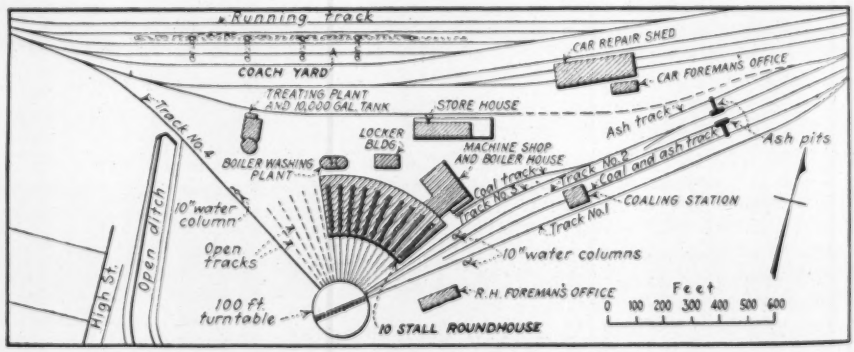


FIG. 2. LAYOUT OF ENGINE TERMINAL

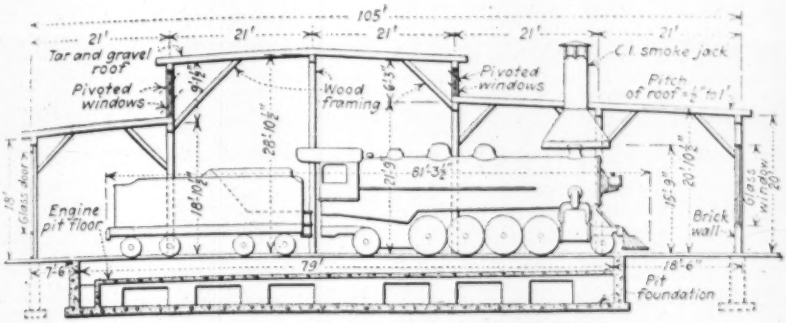


FIG. 3. CROSS-SECTION OF ROUNDHOUSE

able amount of filling was required, and a creek forming a surface drain for part of the city was diverted so as to pass under the end of the yard in a concrete double-barred box culvert having two openings 5 x 8 ft. to give ample flood capacity. Before the filling was placed, the roundhouse foundations and pits were built

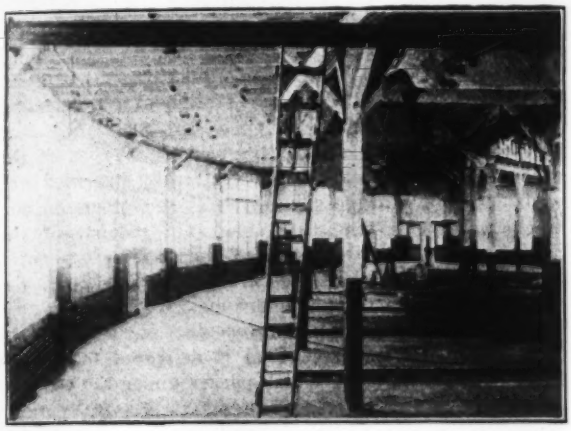


FIG. 4. GLASS WALLS MAKE LIGHT ROUNDHOUSE

to rail level, or 7½ ft. above the original surface, thus saving time, although the cost was slightly greater than if the filling had been placed first. Most of the foundations are on about 4 ft. of loam overlying a 28-ft. bed of quicksand, the surface of which is 8½ ft. below rail level.

Roundhouse and Engine Pits

Timber frame construction, with brick and glass walls and timber roof, was adopted for the roundhouse for economy and light weight in view of the foundation conditions. The building, Fig. 3, is 105 ft. deep, divided into five 21-ft. bays, the inner and two outer bays having a low roof while the others form a wide and high monitor. An exceptionally well-lighted interior is obtained by the extensive use of glass, as indicated by Fig. 4, wood sash being used in the monitor and the flat skylights over the outer bay, and steel sash being used in the walls and swinging doors. These doors have an unusually large proportion of glass. Diffused light for night work is provided by electric flood lights set on the rear wall, between the stalls.

In each stall is an engine pit 79 ft. long. Two of these pits are connected by a transverse drop pit for handling driving wheels and two other pits are similarly connected by a smaller drop pit for truck and trailer wheels, a traveling pneumatic jack being operated in each drop pit. The engine tracks are carried over these drop pits by removable rails 10 ft. and 6 ft. long respectively, each of these being 100-lb. rail trussed by a road with flattened ends riveted to the rail base, as shown in Fig. 5. Between each pair of stalls are arranged four pipe lines; one for hot water for washing out boilers, a steam blower line for starting fires, an air line for operating pneumatic tools and testing brakes, and a water line for fire protection and general utility. The boiler washing plant operates on a circulating system, sludge and scale being removed from the return water so that the water can be used over again and heat thus saved.

To reach a good foundation the pit walls had to be carried to a depth of about 8 ft. Concrete was saved by leaving an open space under the pit floor and by forming openings in the lower portions of the side walls (see Fig. 5). Projecting curbs at the top protect the heating pipes laid along the walls. The pit tracks are of 100-lb. rails, secured by clips and nuts on anchor bolts and resting on ½-in. plates spaced 2 ft. apart. At the ends and middle of the pit the walls are increased in thickness and capped with 7 x 16-in. jacking timbers. A 4-in. brick floor is laid on 2 in. of sand and 6 in. of cinders, with grated sumps draining into the pits, as shown.

A one-story brick building 80 ft. square, with flat roof supported by combination trusses, adjoins the roundhouse and contains a machine shop for running repairs to the locomotives, an engine room and a boiler room. The boilers, served by a 100-ft. reinforced-concrete chimney, supply steam for an air compressor and

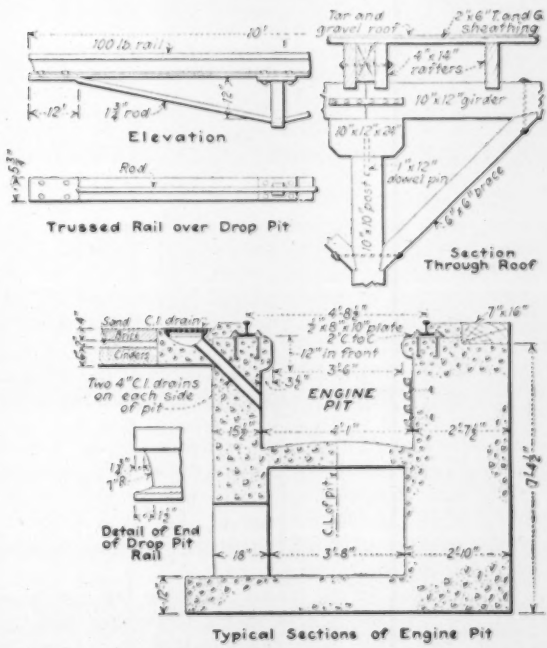


FIG. 5. ENGINE PIT, DROP-PIT RAILS AND ROOF FRAMING

FIG. 6. TURNTABLE WITH TRACTOR AND END TRUCKS

the boiler washing plant and also for heating the buildings and the cars in the coach yard. Concrete is used for the boiler room floor and mastic on concrete elsewhere, except that a cinder floor is used for that part of the shop assigned to blacksmith work. Steam pipes

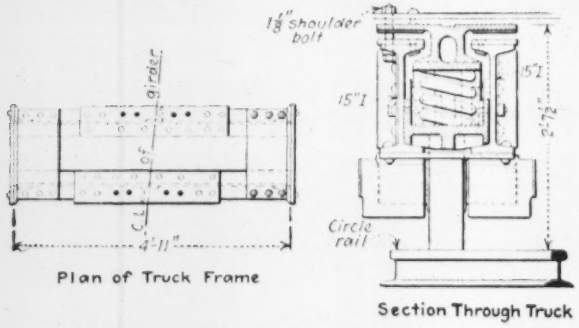


FIG. 7. DETAILS OF SPRING TRUCK FOR TURNTABLE

carried underground in the buildings are insulated and laid in split tile conduits. Concrete conduits are used for steam and other piping laid in the yard.

Turntable Truck Design

Shock absorbing end carriages or trucks are special features of the 100-ft. center-bearing deck girder turntable, Fig. 6. The trucks (Fig. 7) are of I-beam construction, each fitted with a pair of cast steel bearing blocks separated by two 8-in. M. C. B. coiled car springs. The roller wheels just touch the circle rail, and the usual 1-in. play between rail and wheel is provided between the bearing blocks by means of the springs. A load of about 24,000 lb. or a net impact load of about 20,500 lb. on the end of the table is required to close the blocks together to a solid bearing. Shoulder bolts between the upper flanges of the I-beams and the upper block on which the main girder rests, hold the trucks in place, lifting those of one end when the opposite end of the table is depressed, all wheels remaining permanently in contact with the circle rail. It is thought that this type of truck provides maximum flexibility in the rocking of the table, relieving it of the greater part of the impact load as engines enter and leave the turntable.

A 35-hp. motor-driven tractor operates the turntable. Foundation piles are placed under the center pedestal and under the circle rail, which is laid on a bench in the concrete pit wall. The radial tracks diverge at an angle of 5 deg. 52 min. and are spaced 14 ft. 1½ in. c. to c. at the roundhouse doors. Flood lights mounted on the roundhouse wall and in the coaling station provide exceptionally good lighting for the turntable and its approach tracks.

As the hard city water is not suitable for the locomotives or stationary boilers, a water softening plant with a capacity of 20,000 gal. per hour has been installed. Soda ash and lime are used ordinarily, in proportions varying with the quality of the water, but an iron solution is also used as a precipitant when the water contains a large amount of solids in suspension. Storage for 100,000 gal. of softened water is provided in a 26-ft. steel standpipe 44 ft. high, Fig. 8. The dosing chamber is on top of the tank and the machinery for mixing the solution is installed in an adjacent building. The sanitary sewer system of the terminal is connected to a city sewer.

A reinforced-concrete coaling station, Fig. 9, of the automatic single-bucket type, electrically operated and with 300 tons storage capacity, serves engines on two tracks leading to the turntable. On account of the nature of the soil, the pit is of the shallow type with a cross feeder or transfer car feeding the 2-ton elevator bucket, the arrangement being similar to that of a plant described in *Engineering News-Record* of March 11, 1920, p. 520. Coal is delivered to a track hopper on a stub track which passes under the coal bin

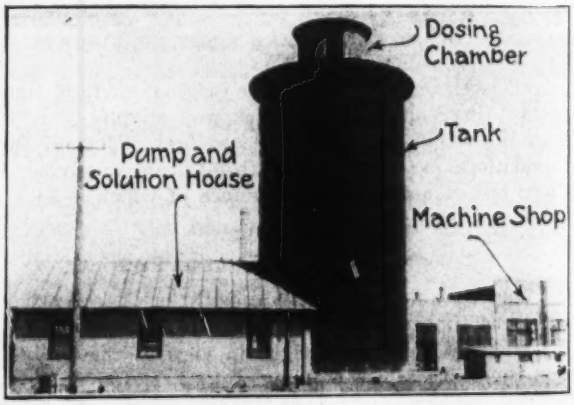


FIG. 8. WATER SOFTENING PLANT AND 100,000-GAL. STANDPIPE

and has a slight ascending grade, the cars being pushed to the end of the track and then fed back by gravity to the coal hopper and ash-handling plant as required. Sand-handling facilities include a 200-yd. open bin for wet sand storage and two steam dryers, the dry sand being conveyed by compressed air through pipes to a 20-ton bin in the top of the coal bin. On each side of the coaling station are two coal spouts and sand pipes, so that four engines can be supplied simultaneously.

Each ashpit has a steel bucket or car to receive the ashes from the engines, the car being operated on an

inclined track at right angles to the engine track by means of a cable and air cylinder, as shown in Fig. 10. The track extends above ground on steel bents to such a height that the drop-bottom bucket delivers the ashes into a gondola car on an adjacent spur track, a third rail supporting the hinged bottom of the car being curved so as to allow the bottom to drop.

Miscellaneous Facilities

Three car repair tracks with capacity for 45 cars and with a shed 145 ft. long over two of them are located between the roundhouse and freight yard. There are also three coach tracks, with capacity for twenty-one coaches, the coach yard being served by pipe lines supplying water, steam, air and gas for lighting. A brick storehouse 30 x 103 ft. with concrete basement for oil storage and 2,950 sq.ft. of open platform, is located between the roundhouse and car repair facilities, to handle supplies for the entire plant. Lavatories, lockers and toilets are provided in a separate brick building, 24 x 45 ft.

Although the improvements now recently completed did not include extension of the freight yard, which is planned for later construction, they did provide a rearrangement of the east ladder track in line with plans for later enlargement of the yard. They include also the installation of a new 50-ft. heavy-duty track scale with capacity of 75 tons per section, designed to meet the latest specifications of the American Railway Engineering Association and U. S. Bureau of Standards. The scale is located on the main switching lead, and at an elevation which forms a modified hump, giving gravity movement off the scale and through the ladder track into the yard.

Grading and culvert work were done by List & Gifford, Kansas City, Mo. The contractor for the buildings was H. D. McCoy, Cleburne, Tex., and on this part of the work the railway's building inspector was A. E. Reily, architectural engineer, Kansas City, Mo., who has furnished much of the information for this article. The water softening and storage plant was built by Graver Corporation, the coaling station by Roberts & Schaefer, the ash-handling plant by William Robertson & Co., and the boiler washing plant by the National Boiler Washing Co., all of Chicago.

Design and construction of the terminal and its connections were under the direction of Frank Ringer, chief engineer of the Missouri, Kansas & Texas Ry., with the construction in direct charge of J. M. Metcalf, principal assistant engineer, and D. I. Stephens, assistant engineer.

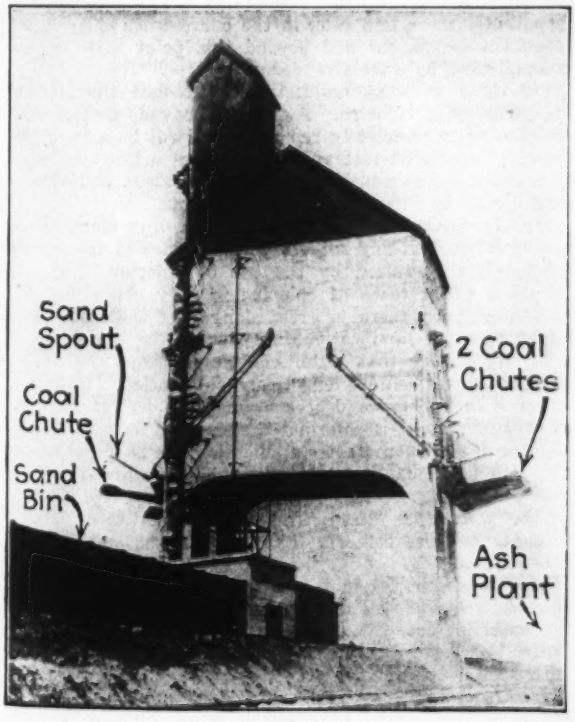


FIG. 9. CONCRETE COALING STATION—SHALLOW PIT TYPE

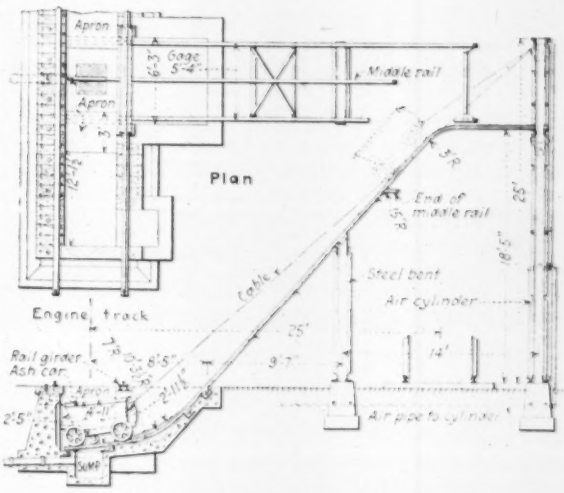


FIG. 10. AIR-OPERATED ASH-HANDLING PLANT

Virgin Growth and Second Growth Timber

Specifications often call for virgin growth or second growth timber, yet the terms are without fixed significance, and the material when delivered cannot be identified positively as belonging to one class or the other.

Virgin growth is generally thought of as slow growing timber, while second growth, due to more favorable conditions, is relatively rapid. A faster rate of growth is evidenced by wider annual rings, which are popularly supposed to indicate stronger and tougher wood in the hardwoods, such as ash, hickory, elm and oak; and weaker and brashy wood in the conifers, such as pine and fir. Hence, for uses in which strength and toughness are essential, second growth is sought among the hardwoods; in conifers virgin growth is desired.

As a second growth forest attains maturity, the rate of growth slows up, and the annual rings may be no wider than in virgin growth timber of the same size. On the other hand, when a slow-growing suppressed forest tree is freed by removing the neighboring trees, it may grow rapidly for a long period. Therefore, it is possible to have some wood with the characteristics of virgin growth and some with those of second growth in the same tree. Furthermore, individual trees in a virgin growth forest may have the characteristics of second growth throughout and vice versa. The Forest Products Laboratory, Madison, Wis., considers it advisable to disregard rate of growth and rely upon density as a guide to quality.

Problems in the Chlorination of Water—II

Seventeen Water-Works Operators Give Experience on the Effect of Temperature on Wastes and Odors, Corrosion of Metals and Efficiency Factors

The data and opinions on tastes and odors and on corrosion of metals due to chlorination were given in the issue of Sept. 8. The present article concludes the symposium.—EDITOR.

Efficiency Factors

OPINION appears to be about equally divided as to whether it is expedient to hold filters responsible for full bacterial efficiency or to depend on chlorine for bacterial results, letting the filter remove particularly the visible impurities. This question is a vital one and the original idea of emergency use only for chlorine has given way, in many cities, to material reliance on it for bacterial efficiency, with the result of prolonging the life of many filters which had long ago reached the obsolescent stage. Many wooden tub filters 25 to 30 years old will have to be replaced now because of actual decay of the staves rather than for inefficiency of final results.

Another efficiency factor is the amount of organic matter chlorine can handle. Undoubtedly water heavy with turbidity and organic material is far more difficult to sterilize. The mass making up the separate particles mechanically offers a barrier to the penetration of the chemical to the bacteria inclosed. Although some of the answers indicate that there is a limiting amount of organic matter, a few operators report no lowered efficiency due to certain kinds of organic matter. Algae, as brought out in the last question, usually reduces the efficiency because it absorbs an extra amount of chlorine, but this effect is not invariable. Not every operator has yet got over the idea that he must meet the U. S. Public Health standards which were never intended for general application. The questions and answers follow:

9. *Does the bacterial reduction effected by an excessive use of chlorine warrant letting down on the possible efficiency of filter plants? In other words, should filter efficiency be allowed to drop with the idea that the bacterial efficiency may be raised by a liberal use of chlorine?*

10. *Can a water be efficiently chlorinated which carries a large amount of organic matter? Does it pay to aid excessive amounts of chlorine in an attempt to remove bacteria to meet the U. S. Public Health standards when the water to be treated carries large amounts of organic matter, especially algae growths?*

11. *What effect have algae growths in reducing the efficiency of chlorine which has been applied to water for sterilization?*

Mr. Gettrust—9. Why excessive use of chlorine? Plants with daily technical supervision should be operated as economically as possible. The present high cost of coagulants warrants the operator in using just sufficient to obtain a clear effluent and obtain the bacterial efficiency by a proper dose of chlorine.

10. Cannot be answered offhand. Each supply has its peculiarities which require separate study.

11. No trouble from algae in our filtered water, but it has been my experience that waters very low in oxygen consumed are difficult to treat successfully with liquid chlorine and avoid troubles due to taste.

Mr. Ellms—9. A reasonable reliance may be placed upon chlorine disinfection to offset lowered filter efficiency. The extent to which one may go depends entirely on the original quality of the raw water, and upon the efficiency of the filters where the latter are used. The use of large amounts of chlorine for such purposes does not seem warranted, but if, in the ordinary course of operation, filter efficiency does fall off, and disinfection is able to maintain a good over-all efficiency, the writer can see no laxity or disregard of the sanitary quality desired if advantage is taken of the efficiency of disinfection.

Attempting to meet the U. S. Public Health Service standards may be commendable but by no means always necessary. These standards, in the writer's opinion, cannot possibly be met in some cases, although easily reached in others. It is very questionable whether these so-called standards are generally applicable to the varied classes of water met with in public supplies, or that non-conformity to them is indicative of a poor grade of drinking water. Here also each case must be considered upon its individual merits.

10 and 11. The disinfection of waters containing much organic matter is difficult, and may be inefficient. Where algae growths are the cause, it would seem as though filtration should be used to remove them, and this treatment be followed by disinfection. If dissolved or colloidal organic matter is present in large amount, the problem is more difficult. Each case would have to be considered by itself.

REPORT FROM BALTIMORE

Messrs. Walden and Powell—9. Undoubtedly water from filter plants inefficiently operated can be chlorinated so as to produce a water of satisfactory bacteriological content to meet the U. S. Public Health standard. The writers believe that intentionally permitting low filter efficiency and covering the defect by sterilization is poor practice and should be discouraged in every instance. However, where it is necessary to filter at a high rate it is desirable to chlorinate the filter effluent in order to produce water of a satisfactory quality.

10. Where it is very difficult to chlorinate a water which contains a large amount of organic matter, particularly those with heavy growths of algae and allied organisms, it has been our experience that an excessive amount of chlorine does not always accomplish the desired results. Apparently there is a peak in the curve when chlorination treatment is efficient and beyond this point little can be accomplished by excessive dosing.

11. Algae growths unquestionably reduce the sterilizing efficiency of chlorine. A water so heavily treated with chlorine as to completely remove algae will be most objectionable from after-tastes and odors due to this treatment. It is much more desirable to remove the algae with copper sulphate or by filtration than by chlorine.

Mr. Armstrong—9. The efficiency of a filter plant should not be lowered in any respect with the idea of making up for careless operation by the use of chlorine. To some people a slight taste of chlorine is very obnoxious, and in winter when there is great danger of the taste there might be some justification in reducing the amounts.

10. We believe that water containing large amounts of organic matter can be effectively chlorinated. When the water with which we deal contains considerable amounts of organic matter, if chlorinated enough to have a residual chlorine several hours after application, the bacterial reduction will be good. It is also noted in the warmer months that there is an increase of bacteria after the free chlorine in the water has disappeared. Sometimes this increase amounts to more bacteria than were in the water before chlorination.

11. Algae growths in the water increase the amount of chlorine required, as the presence of these organisms in the water increase the amount of oxidizable organic matter.

Mr. Van Loan—9, 10 and 11. No results in Philadelphia with such waters.

Dr. Hale—9. New York City does not operate filter plants at the present time, but it is our opinion that the use of chlorine to produce bacterial efficiency justifies higher

rates of filtration, provided the water is properly clarified and purified and provided the question of continuous efficiency of the chlorination is taken into account, i.e., adequate supervision to prevent any breakdown of service.

The question of meeting the U. S. Public Health standard depends, to my mind, entirely upon knowledge of the kind and amount of contamination, probability of typhoid, character of supply, etc.

10. New York's supplies carry only small amounts of color and organic matter with the exception of algae growths at periods.

11. Algae increases the dosage required to maintain efficient B. Coli removal, but not to excessive amounts. A maximum dosage of our supplies would probably be 0.4 to 0.5 p.p.m. However, we regulate algae growths by various other means, such as treatment with copper sulphate, storage, aeration and change of draft from one level to another and one reservoir to another.

Mr. Laboon—9. Emphatically no. We are of the same opinion as the state boards of health in this section of the country, which demand that the filter efficiency be maintained at the highest degree possible so as to furnish a safe, potable product. Chlorination is resorted to as a precautionary rather than a primary measure.

10. A water carrying a large amount of organic matter can be efficiently chlorinated, although the element of taste and the question of desirability enter in. Regarding the addition of excessive amounts of chlorine in an attempt to remove bacteria to meet U. S. Public Health standards, this must be done if it is desired to use certain waters on interstate carriers. For ordinary purposes the U. S. Public Health standard is at times too rigid for practical adoption, especially where large amounts of organic matter and algae growths are present.

11. Algae growths reduce the efficiency due to the absorption or oxidation of the algae by the chlorine; although this reduction we believe is but very slight. Local conditions, we believe, have considerable bearing on all of these matters and our answer is but a generalization.

Indianapolis Practice

Mr. Jordan—9. Your question reminds me of the effort people in Indianapolis made in 1908 to control the operation of the various parts of the filtration plant. The real question, as I see it, is in what rests the safety and satisfaction of the consumer. Does it make any difference to him if filter 4 has not shown a satisfactory percentage removal of B. Coli on the last day of February? So long as the final product is healthful and not distasteful I do not see that it makes any difference what is the operating efficiency of the different parts of the purification plant. Provided (spell this word provided with capital letters) that the care of the chlorination apparatus is good and that there is a duplicate or triplicate installation of chlorine machines, so that not for an instant will the chlorination be stopped, and provided that the supply of chlorine is kept on hand. Naturally, it would not be proper to reduce the efficiency of operation so that if there should be a half hours' interruption of the chlorination process there would be an ill effect upon the health of the public.

10. Broadly speaking, No. Referring to the U. S. Public Health Service standard for water on interstate carriers, I beg to remind you, like a great many other people, of the emphatic language of Mr. Phelps at the meeting, in 1915, of the Indiana Sanitary and Water Supply Association, that this standard was not to be interpreted as extending to the control of public water supplies. There has been no official modification of the original language used which justifies using this standard in connection with the rating of the public water supply.

11. I have had no experience with an algae growth so heavy as to appear to affect the efficiency of chlorine. It would occur to me that the algae would manifest their presence in other objectionable ways rather more quickly than would be noted in reduced chlorination efficiency.

Mr. Buzzell—9. In a well regulated plant the treatment should be properly balanced in all steps throughout the process, and only an emergency should warrant an excessive use of chlorine to take care of any let-up in the efficiency of the other important steps of the purification treatment.

10. This question could be more easily answered had it designated between chlorination alone or in connection with coagulation and filtration. Some waters carrying a large amount of organic matter are difficult if not impossible to chlorinate efficiently without leaving a disagreeable taste.

There are well regulated filter plants producing an effluent which does not meet the U. S. Public Health standards for a drinking water 100 per cent of the time, yet the water is perfectly safe. We have found, in highly colored waters demanding a high chlorine feed to meet the U. S. Public Health standards, that they contain more non-fecal B. coli than water of low color. We believe it does pay to aim to meet U. S. Public Health standards at all times with our local conditions of raw water.

11. We have some trouble in late summer with anabaena and other green algae on filter walls and troughs. Scrubbing with a solution of copper sulphate kills the growth. Chlorine at this station is applied to the filtered water. We have, therefore, never had trouble due to algae.

Report From Milwaukee

Mr. Bohmann—9. No. Filter efficiency should be kept at as high a point as possible at all times, so that if there should be any leaks, or any sudden increase in the bacteria going to the filters, the small amount of chlorine used after filtration will be able to cope with the increase.

10. Decidedly yes. Even raw sewage can be efficiently chlorinated. No matter how much organic matter is in the water, if enough chlorine is added to keep the free chlorine between 0.02 and 0.08 p.p.m. a good reduction in the bacterial count can be effected.

11. From our experience with the experimental filter plant on days when the algae were exceptionally high in count, up to 600 to 1,000 per c.c., there was no difference in the bacterial reduction produced by the chlorine. The effectiveness was always as usual, giving about 95 to 98 per cent reduction, and also the usual reduction in the B. Coli.

Mr. Graf—9. When the cost of coagulants required to produce a water of desired purity is out of all proportion to the cost of the chlorine necessary to produce the same results, the use of a large amount of chlorine is warranted.

10. Yes. No. 11. Algae growths, after water has been sterilized with chlorine, show no effect on bacterial content.

Mr. Birdsall—9. Decidedly No. (See *Journal* American Water Works Association, May, 1920, p. 384.) 10. No, the water should be filtered and copper sulphate used for algae elimination. 11. No experience.

Dr. LaCroix—9. No. I do not consider this a safe expedient. 10. It depends on amount. If the water is of zero turbidity, chlorination will produce a satisfactory water, provided the organic matter is not too high. The question of meeting the U. S. Public Health standards is more or less a local problem, varying with the character of the raw water, method of treatment, and public attitude toward slight tastes and odors. I believe an operator should strike a reasonable balance between the number of bacteria present, their character, and public sentiment regarding tastes and odors.

11. I have never been able to determine beyond a doubt what effect the algae growths have in reducing the efficiency of chlorine, but it has been noticed that the after-growth is much harder to eliminate when algae are present.

Mr. Gillespie—9. My feeling is that the bacterial efficiency of filters need not be kept at its maximum if chlorination is employed, but that such bacterial efficiency in the filters should be obtained as accompanies 100 per cent efficiency in clarification. 10. This seems to be the most serious condition to face, from the standpoint of possible complaints. The water can be disinfected but there are sure to be complaints from consumers due to tastes.

11. As an indication 4.0 to 4.5 lb. per m.g. are necessary when algae are excessive and 0.8 to 1.2 lb. are sufficient at other seasons. Algae and other factors conducive to taste should be recognized only with a view to their elimination and not as a reason why chlorination should not

be employed. The stand should be taken that waters that need disinfection must have it, taste or no taste. No other method of disinfection on a practical scale has yet appeared.

Mr. Wilhelm—9. There should be no letting down in the efficiency of the filter plants at any time with the idea that chlorine can do the work of filters. The efficiency of chlorination depends to a great extent upon the clarity of the water after filtration. The excessive use of chlorine in many cases seems to be the result of an effort to sterilize water by chlorination rather than by filtration. When this is done there is no doubt a considerable amount of free chlorine left in the water. Our experience has been that water should be in such a state after filtering that a maximum amount of 0.40 p.p.m. chlorine will reduce the bacterial count to not more than 60 bacteria per c.c. with no B. Coli present.

10. It is difficult to chlorinate efficiently water carrying a large amount of organic matter. Organic matter should be removed from the water before chlorination to get satisfactory results.

11. Possibly many of the tastes and odors found in the water are caused from the action of chlorine on the algae growths which have not been removed by filtration. It is also probable that algae would have the same effect of retarding the action of chlorine on bacteria as any other matter which might be in the water and has not been removed by filters.

On the Canal Zone

Mr. Bunker—9. In two of the three purification plants on the Canal Zone there has always been a multiplication of harmless bacteria in the settling basins or filters or both which I have never been able to stop permanently due to certain existing conditions which it is considered inadvisable to change. At these plants chlorinators were installed principally for the purpose of reducing the bacteria in the filtered waters below 100 lb. per c.c. The amount of chlorine varies from 2.5 to 3.25 lb. per m.g. which cannot be considered as an excessive amount. In the third plant during the dry season the raw water becomes quite clear so that a minimum amount of alum may be used to remove all the color and turbidity. However, as there is only one point at which the alum may be applied, i.e., between the aeration basin and mixing chambers, and as the settling period is too long with the normal flow of water through the plant, the amount of aluminum hydrate which reaches the filters and is deposited on the sand is insufficient to form a mat of the proper thickness. As a result there is a drop in the efficiency of the filters and the bacteria in the effluents increases to more than 100 per c.c. As long as the physical conditions of the effluents remain satisfactory I do not consider it necessary to increase the alum to such a point that a heavier mat will be formed on the filters to effect the removal of 100 or 200 bacteria when the normal amount of chlorine in use will reduce the latter to less than 50 per c.c.

It is not advisable to reduce the alum at any purification plant (in order to reduce the cost of the coagulant) to such a point that the physical qualities of the filter effluents will be affected even though the addition of chlorine will reduce the bacteria of the mixed effluents to less than 100 per c.c. Neither should the alum be reduced to such an amount that dirt will penetrate into the main body of the sand.

In those purification plants in which chlorine is added to the filtered waters, I am of the opinion that it is unnecessary to use an excess of alum, above the amount necessary for the removal of color and turbidity, in order to reduce 200 or 300 bacteria per c.c. to less than 100 per c.c. provided that the amount of chlorine required is not so large as to impart a taste and odor to the filtered water.

10. An unfiltered water which contains a large amount of organic matter cannot be efficiently chlorinated, if by this phrase is meant the reduction of the bacteria in all parts of a distribution system to conform with the standards of the U. S. Public Health Service. However, the majority of the water-borne disease germs in polluted water supplies may be killed in nearly all cases if the chlorine is added in as large amount as possible without imparting a disagreeable taste to the water. It would not pay to add an excessive amount of chlorine to a water supply containing a large number of algae for the purpose of reducing the bacteria below 100 per c.c.

11. In the latter part of 1920 a large multiplication of bacteria occurred in an open reservoir in Ancon in which chlorinated filtered water was stored. A sudden growth of chlorophyceae furnished a food supply for the few bacteria in the disinfected water. In this case the plastering of the rough interior walls stopped the multiplication of bacteria by removing the crevices, holes and rough surfaces to which the algae adhered and grew. Similar trouble was not experienced with a covered reservoir in which the same water was stored.

Mr. Merrill—9. No filters are used in any of the water supply systems in the Philippines.

10. Our experience with the Manila water supply seems to indicate that water high in organic matter cannot be sufficiently chlorinated. The use of an excessive amount of chlorine with the object of obtaining a higher degree of bacterial reduction has not been found effective.

11. No systematic investigations have been made in reference to the elimination of algae causing disagreeable odor and taste, as these organisms do not in general occur in abundance in Philippine waters and so far have caused no serious difficulties.

Dr. E. L. Walker, of the Bureau of Science, proved conclusively that the amoebae cultivable from water are not pathogenic (see his paper in the *Philippine Journal of Science*, Vol. 6, Sec. B, 1911). No systematic work has been done on the effect of chlorination on amoebae since Dr. Walker's time. We can generally cultivate amoebae from the Manila water supply which has been chlorinated at the outflow of the reservoir.

New Device for Testing Subgrade Bearing Power

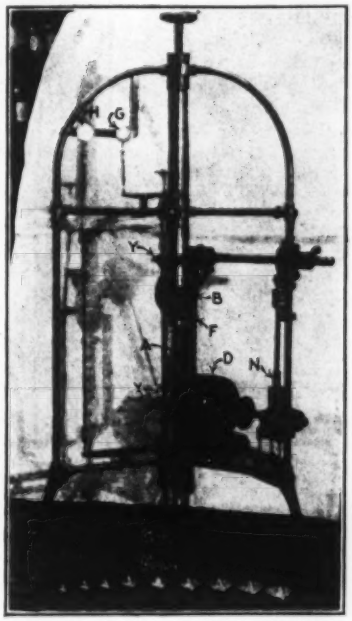
New Machine Gives Six Loads per Minute, Varying From Zero to Maximum to Zero, Like Passing Vehicle

By H. F. Clemmer
Testing Engineer, Division of Highways, Springfield, Ill.

TO DETERMINE the action of the subgrade under hard-surfaced roads, when subjected to repeated loads such as would be caused by the movement of heavy vehicles on the surface, the Illinois Highway Testing Laboratory has designed a new apparatus termed the repeating-load bearing-power determinator.

The pressures to which a subgrade under a hard-surfaced road is subjected may be of three kinds, depending upon the way in which the load is applied to the surface. If the surface is rough, or if a truck wheel hits an obstruction, an impact force is produced, while if a truck stops for any appreciable length of time a static load is occasioned; the action of the subgrade under these two classes of loads is being studied by use of the Goldbeck impact bearing-power determinator and the Illinois static-load bearing-power determinator. The repeating-load bearing-power determinator is being used for making a study of the subgrade when subjected to a third condition—that of a great number of vehicles passing over the surface. With its aid the subgrade action can be noted when subjected to a load increasing from zero to a maximum and then back to zero again in approximately the same time and magnitude as in case of a heavy wheel moving over a rigid surface.

Briefly described, the determinator (see the accompanying illustration) consists of a spring *A* for producing pressure; a cam *B* which varies this pressure; a plunger *C* which transmits this pressure to the soil; a one-sixth horsepower direct-current motor *D* which drives the cam at a constant speed of six revolutions per minute; a footing *E* which is attached to the bottom of the plunger and distributes the pressure to the soil (footings of different areas are shown at the bottom of the machine in the illustration); a scale *F* upon which the pressure desired is set; an Ames dial *H* which registers the action of the soil under the repeating loads; a wheel *I* which lowers the cam section; and a second Ames dial *G* which registers the vertical movement of this section. Motor power is furnished by a power unit carried on the truck which transports the determinator.



TO TEST ROAD SUBGRADES

The action of the determinator is as follows: The machine is leveled up so that the plane of the footing on the bottom of the plunger is parallel with the surface of the soil. By loosening the set screw *n* and applying a crank to the shaft leading to the cam, the pointer on the upper end of the spring is set approximately to the pressure desired. Fine adjustment of the pressure can be made by turning the lower bearing upon which the spring rests. Set screw *n* is then tightened and the power unit attached. The motor, in causing the cam to revolve, varies the pressure on the soil from zero to a maximum and then back to zero six times per minute. As the soil is deflected under the pressure applied it is necessary to lower the cam section in order that the pressure remains constant. This lowering movement is accomplished by turning the wheel *I* and is registered on the dial *G*. Dial *H* registers to 0.0001 in. the action of the soil beneath the footing.

In order that the soil might be permitted to recover from the pressure without being opposed by the dead load of the plunger section, it was necessary to design an attachment which would carry this load immediately after the pressure was released. A shaft *X* and a counter-cam *Y* were attached to the frame to pick up this load and carry it until just before the pressure was again applied.

Different sizes of footing are being used in order to get some relationship between the action of soil under loads applied to different areas. The loads applied to these footings vary between 5 and 50 lb. per square inch.

This apparatus is at present being used in the subgrade investigation work carried on in connection with the Bates experimental road. With the co-operation of the U. S. Bureau of Public Roads an attempt is being made to correlate the results obtained in the field with the bearing-power values as indicated by laboratory experiments at Washington.

Timber Surveying and Cruising

A special class of survey work is that of "cruising" timbered areas to make the boundaries, show topography and indicate timber conditions. Details of this work are given in the following abstract of a paper in the *Cross Tie Bulletin* by G. C. Graeter, supervisor of lands of the Western Tie & Lumber Co., St. Louis, Mo.

In cruises made by the U. S. Forestry Bureau and cruising firms on government lands and large bodies of high-class saw-mill timber it is general practice to cover 20 per cent of the area by actually surveying two 4-acre lots in each 40 acres, these sample areas being 2 x 20 chains. The surveying or compass party precedes the "cruiser" or tallyman who counts trees and note stheir species and size. Such a party requires at least three men and more often has five: a compass man, two chainmen, an axeman or flagman and the cruiser. Cruising done in this way is too expensive and too slow for the tie business.

For ordinary mapping and cruising by one man the writer has a field outfit consisting of a Brunton hand transit or compass, hand level or clinometer, a 50-ft. metallic tape, a 10 x 12-in. sketch board, a scale divided 66 parts to the inch and cross-section paper divided 10 parts to the inch.

It is the practice to start at some known corner of the tract and proceed around the boundaries of the area, taking bearings with the compass, pacing distances along the outside lines, and locating all points of importance which can be seen from the outside lines. The lengths of the section lines and smaller subdivisions can generally be secured from government maps or from the owner, and if secured in time they should be plotted on the cross-section before starting field work.

On the traverse of the boundaries note is made of all streams and of all slopes over 7 per cent or 4 deg. After the outside lines have been traversed the track is bisected diagonally in both directions from two corners. For every 20 acres a 4-acre area is paced, in which trees are counted and their size and kind noted. On these diagonal traverses the slopes over 7 per cent or 4 deg. are located; also stream crossings and direction of flow, roads, trails, clearings, swamps, houses and all natural features and works of man which would help or hinder operations.

For the timber estimate the Doyle rule, also known as the Connecticut River or St. Croix rule is used. This deducts 4 in. from the diameter of the log as an allowance for slab, squares one-fourth of this remainer and multiplies the result by the length of log in feet; the last result is the content of the tree or log.

A rough sketch of the area is made as the tract is cruised, and ample notes are taken. When the field work is completed the tract is mapped on a scale of 660 ft. to the inch, and all information is placed on the map.

These methods are applicable to a tract of any size, but if the section lines have not been run and cannot be located in the field, they should be run and "blazed." The work should be accurately done with transit and chain or by the transit and stadia method. The latter method is speedier and more accurate in country having steep slopes and gullies, or in flat country if the work has to be done with green and inexperienced chainmen. Corners should be located or determined and set, and should be made as permanent as possible, witness and marker trees being used in and blazed or reblazed, the notes being fully recorded. It is good practice to paint outside boundary and section lines red, half section lines yellow, and intermediate smaller or special lines green. Woods foremen can then readily locate themselves on large tracts with which they are not familiar.

Chicago Elevated Railway Raised

Jacks in Timber Bents and Cribbing Lift Cross Girders—Columns Lengthened—Through Span Replaces Deck Span

TO PROVIDE for a new station at Grand Ave., on the Franklin St. line of the Northwestern Elevated R.R., Chicago, it was necessary to raise the rail level 5 ft. and to replace the original deck span across Grand Ave. by a through span with shallow floor in order to obtain headroom for placing the station under the structure and with a clearance of 14 ft. above the street. This change in elevation involved changing the profile for a distance of about 1,100 ft., so that instead of being level it has grades of 1.2 per cent up to the new elevation, with the track level through the station. Fig. 1 shows the work in progress, and the general arrangement of the reconstruction is shown in Figs. 2 and 3.

Raising the Structure—In the Franklin St. elevated line four rows of 5-ft. deck latticed girders of 45 to 51 ft. span, forming the track stringers, are framed between 6-ft. cross girders of 43 ft. span, which in turn are framed between the webs of H-section columns at the curb lines. Plate kneebraces stiffen the columns laterally, and for longitudinal stiffness there are diagonal latticed struts from the faces of the columns to the track stringers. To provide for lifting, two four-post braced timber bents were placed near the ends of each cross girder, being supported on cribbing built up to the necessary height in the roadway between the curbs and the car tracks. Screw jacks or building jacks of 15 tons capacity were placed between two courses of the cribbing, there being four or six jacks to each bent according to the location.

To release each column from its foundation it was necessary to remove the concrete filling in the base, in which were imbedded the four anchor rods with upset threaded ends. Some of the nuts on these rods could not be unscrewed and were burned off.

All the work of raising the structure was done during the daytime and without interference to traffic on the elevated line or in the street, except that the timber bents blocked the sides of the roadway. The work of jacking began at both ends and was carried out on one bent at a time, with an average lift of 2 in. at each operation. The total lift for each cross girder was chalked upon the columns and no girder was raised more than 2 in. at a time.

As fast as the jacking proceeded, the cribbing was built up and wedged tightly under the column base and the timber bent, thus keeping the structure in proper alignment and in stable condition. For additional lateral support to the structure, heavy timber inclined braces were set near the crossgirder in alternate spans, with their lower ends butted against blocking laid along the face of the curb and their heads notched to fit the bottom chords of the longitudinal girders. In lifting, about 30 men were employed to work on the jacks and to build up the cribs and wedging. A day's work averaged an aggregate lift of 6 ft., and the lifting occupied about twelve working days.

Lengthening of the columns was effected in most places by removing the old column footing or shoe and splicing on a new bottom section, Fig. 4, which fitted into the old shoe. At the lower ends of the inclines, where this method could not be used owing to the light lift, castings were placed between the old column footing and the pedestal, or in some cases the old column

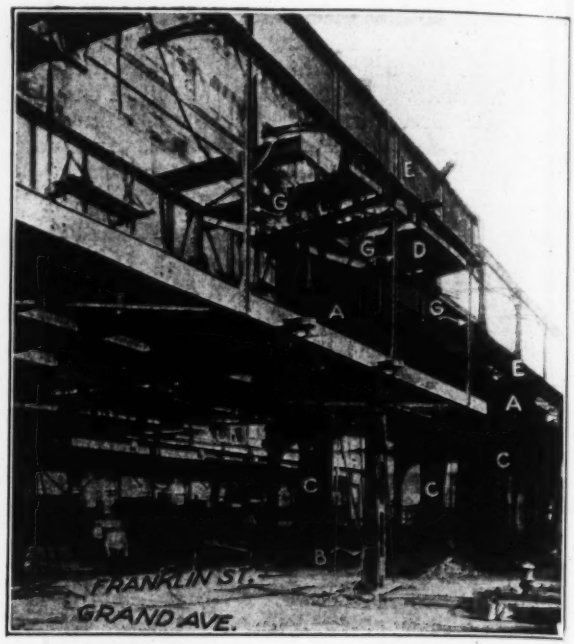


FIG. 1. ELEVATED RAILWAY RAISED 5 FT. FOR NEW STATION

A—Cross girders between columns. B—New section spliced on column to increase its height. C—Timber jacking bents under cross girders. D—Cantilever platform girder on top of old cross girder. F—Rear girders of platform. F—Through girder span over Grand Avenue, with platform joist on top. G—Hangers. H—Framing of station deck or mezzanine floor.

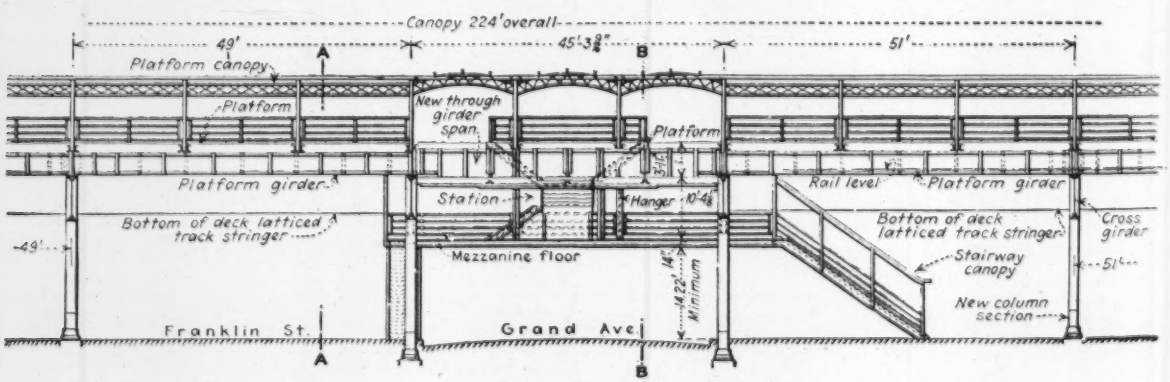


FIG. 2. ALTERATIONS FOR NEW STATION ON THE CHICAGO ELEVATED RAILWAY

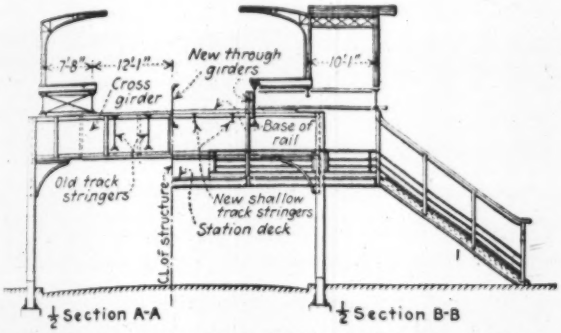


FIG. 3. CROSS-SECTION SHOWING RECONSTRUCTION

was cut off for a sufficient length to permit of splicing on a new bottom section. Where the castings were used, a socketed anchor bolt was screwed upon the original anchor bolt in order to reach the new position of the column shoe (see Fig. 4).

To compensate for the inclined position of the deck, it was necessary to cut out the rivets in the connections of the cross girders to the columns and knee braces, the girders on the new work standing at a slight angle to the columns (see Fig. 4). In some places it was possible to make this adjustment by reaming the rivet holes in the columns and hitch angles on the cross girder, but in other places new connection angles were fitted. All diagonal bracing from track stringers to columns had to be cut loose, as the columns remain vertical while the stringers are inclined. These changes were taken care of by reaming the rivet holes or fitting new connection plates.

Changing the Grand Ave. Span—As the 5-ft. deck trusses forming the track stringers of the 45-ft. span over Grand Ave. were too deep to permit of placing the station under them, it was necessary to replace them with through plate girders carrying a shallow floor system. This work was made particularly difficult by the heavy traffic on both streets, coupled with the fact that these streets have double-track car lines with overhead wires and cables. For the removal of the old girders, traffic had to be operated on one track at a time between the two adjacent stations at Chicago Ave. and Kenzie St. As traffic did not permit of this being done on a weekday it was done on Sundays, one day being sufficient for the work on each track.

Owing to the small spaces in the network of wires under the structure it was necessary to cut the girders into small pieces for lowering to the street, this work being done with oxy-acetylene torches. These wires and the street car traffic also prevented the new girders from being hoisted into place. The girders were placed, therefore, on the abandoned track in the span north of Grand Ave., and were rolled into position before the track was removed. It will be noted that the ends of these girders rest upon the top of the old cross girders, with their chords dropped betwen the latter only a sufficient depth to carry the new floor system.

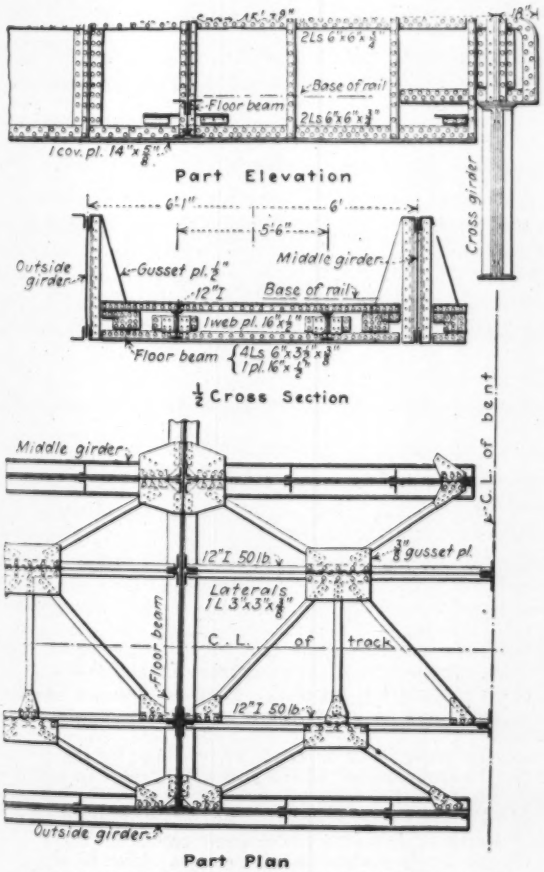


FIG. 5. THROUGH SPAN WITH SHALLOW FLOOR

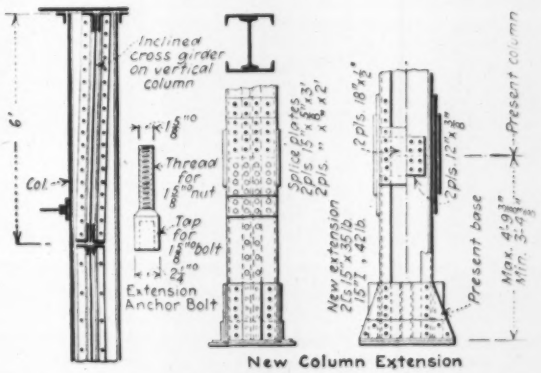


FIG. 4. DETAILS OF RECONSTRUCTION WORK

There are three of these 54½-in. through girders, Fig. 5, the outer ones having the platform joists supported on their top chords. Plate girder floor beams 16 in. deep are riveted to web connections on the girders, and between them are framed 12-in. I-beam stringers upon which the track ties are laid. The two old cross girders were reinforced with two cover plates on each flange.

Station Construction—The station building is located on a mezzanine floor approached by stairways from the sidewalks and having stairways leading to the two side platforms. Its deck framing is carried partly by the columns and partly by hangers attached to the track girders and platform girders. Cantilever girders placed on top of old cross girders and extending over the sidewalk carry the outer platform framing at the station stairways. The platforms are 224 ft. long and 10 ft. wide, the width being increased to 20 ft. at Grand Ave. Canopy roofs over the platforms are carried by cantilever ribs forming extensions of posts at the back of the platform. The station proper, about 45 x 40 ft., includes a ticket booth, waiting room space, newsstand, heater, two toilet rooms and a porter's closet.

All work was done by contact, except that the railway company's force made the changes in tracks, third-rails and cables incidental to the replacing of girders in the span over Grand Ave. For the raising of the structure and placing of new steel the contractor was the Brennan Construction Co., the steel being furnished by the Hansell-Elcock Co. The W. J. Scown Building Co. had the general contract for the station building and miscellaneous work. The design and execution of this alteration were under the direct supervision of C. M. Mock, chief engineer of the Chicago Elevated Railroads.

Outline of Highway Research Program

A paper by W. K. Hatt, director, Highway Research Committee, National Research Council presented at the Conference on Highway Economics, University of Maryland, July 27, 1921

FOR the purpose of a co-ordinated and comprehensive program of highway research the writer has been endeavoring to bring into the picture all the elements of the situation in highway transport—engineering, including vehicle and road; economics of transportation; administration; finance. Some comprehensive and logical assemblage will be helpful.

Individuals in industry who have endeavored to state the problem in approximate statistics tell us that there are 10 billions of dollars invested in self propelled vehicles; that the turnover is 3 billions annually; that there are 10 passenger vehicles to 1 freight vehicle; that the problems of speed and safety are most important; and that the annual expenditure for operation of vehicles is 12 times the annual expenditure on the roads. The field of research on cost of vehicle operation arising from the road surface and from the vehicle itself must, therefore, be kept in the foreground.

It appears that there are many dimly seen figures which should be advanced from the background; there is much that is unknown. We may ask a few questions which cannot be completely answered:

Fundamental Questions in Highway Transport

The Transport Unit—(1) What is the economical highway truck unit for each of the several situations, e.g., intercity, farm market? What is the cost of transport arising from vehicle and from road?

(2) What is the relation of this economical unit to other systems of transport, e.g., electric and steam, in a unified system?

(3) To what extent, as a matter of public policy, should any transport unit be indirectly subsidized?

(4) What traffic regulations should be imposed on such economical unit over other types of road? What fees should be charged for service rendered to vehicle by the road?

(5) What should be the proportion of the total traffic supplied by such economical unit to justify a special design of road for such unit?

(6) What prediction can be made of future changes in general traffic and what is the influence of these on the economics of the present situation?

(7) How should passenger traffic over the highway be evaluated?

The Road—(1) What type of road paving should be selected for a specified transport unit?

(2) If the road cannot be economically fitted to the truck transport unit, can the latter be modified in design to fit the road?

(3) How should the design of the road and paving be modified to meet changing conditions of subgrade, climate, etc.? How shall sub-soils be improved?

(4) What sum of money is the locating engineer justified in spending to avoid increase in distance, curvature, rise and fall, maximum grade, maximum curve?

(5) What system of maintenance and organization is best fitted for types of roads, differing in traffic, in materials, and in climate?

(6) What is capacity of a road of given width for type of vehicle as expressed in vehicles per hour, ton-miles per year, etc.? What is the appropriate unit for expressing traffic for various purposes?

(7) (In construction many questions arise in selection, production and economical use of materials, standardization and regulation.)

(8) How may the volumetric changes in roads be overcome?

(9) What is the economical life of various types of roads, that is, when maintenance charges exceed earning value?

Administration—(1) What should be the policy in control of truck and bus transportation systems, terminals, routing, etc.?

(2) What police regulations should control use of roads?

(3) What is the best administrative and executive organization for administration and operation of roads?

(4) What principles should govern the selection of a system of roads in its various parts, as influenced by interstate, intra-state, county, local traffic, etc.?

Financing—(1) What should be method of financing construction and maintenance of roads? What portions of cost from long term bonds, and what from current funds? What form of bonds should be issued and how create a market for them?

(2) What should be the relation between life of bonds and economical life of road?

(3) To what extent do social betterment, military use, i.e., social value, and other imponderables enter into highway policy?

(4) What should be the distribution of costs as between Federal, State, county, township, property benefited, the user and other units?

(5) How shall the future maintenance charges on completed road systems be met? Shall the user pay all of these?

(6) How shall safety be ensured on the roads?

Answers to these questions cannot be made without data that are at present unavailable. Research is necessary and a mobilization of the efforts of research agencies in a comprehensive program. The highway research committee of the division of engineering of the National Research Council has undertaken the co-ordination of such research. The National Research Council will not engage in research directly.

The tabulation reproduced herewith is devised to indicate the field of research as divided into subfields in which research should be developed and from which data should come to enable answers to be made to these questions among others. Some of the studies that should be made are as follows:

(1) To develop a traffic census blank. Here a traffic classification must be made, the purpose of the census determined, and the various forms and instructions standardized.

(2) In order to determine the cost of transport a statistical table must be made that notes all of the elements of cost; sometimes only a few of these are reported.

(3) To study the operating costs of elements entering into location of highways, such as distance, grade, curvature.

(4) To study loads on roads as produced by the vehicle.

(5) To study design of vehicles with a view to lessening their effects on the road.

(6) To study supporting power and improvement of subgrades and the relations to design of paving.

(7) To study resistance of concrete slabs to alternate stresses and to surface loads.

TENTATIVE OUTLINE OF THE FIELD OF HIGHWAY RESEARCH

ECONOMICS

TRAFFIC STUDIES (REGIONAL)
- Distribution in Region (Traffic Blank)
- Character
  - Vehicle
  - Weight and Distribution
  - Speed
  - Tire (condition)
  - Commodity
  - Length Haul
- Method of Expressing Unit of Traffic
- Predicted Changes
- Other Traffic on Steam and Electric Roads
- Central Sources of Traffic

COMMUNITY NEEDS
- Systems of Roads in Classes for Industries, etc.
- Intangibles

COST OF TRANSPORT
- Capital Cost
  - Road
  - Vehicle
- Fixed Charges
- Overhead
- Operation
  - Maintenance
    - Routine
    - Replacement on Road
    - Replacement on Vehicle
- Equivalent Units
  - X-Auto-Y-Ton Truck, etc.
- Economic Life

ECONOMICS OF LOCATION
- Cost of Distance
- Rise and Fall
- Curvature
- Ruling Grade
- Ruling Curve

FINANCING
- Bonds
- Taxes
- Fees, etc.

HIGHWAY VALUATION
- Increment of Land Values

OPERATION

CONTROL OF TRAFFIC
- Routing
- Terminals
- Franchises
- Police Regulations

ACCIDENT INSURANCE

PLANNING SYSTEMS OF TRANSPORT
- Financing
- Environment
- Relation to Other Transport Organization

FINANCING
- Bonds, Taxes, Fees

DISTRIBUTION OF COSTS
- Traffic
- Property
- Political Units

MAINTENANCE SYSTEMS

MAINTENANCE MACHINERY

MAINTENANCE METHODS
- Routine
- Replacement
- Snow Removal, etc.

TRAIL MARKING

COST ACCOUNTING

SAFETY

DESIGN (ROAD)

SUBSOIL STUDIES
- Properties
  - Physical
  - Mechanical
  - Chemical
- Drainage
- Supporting Power
- Improvement by Treatment
- Effect of Road Deformations
- Effect of Climate
- Distribution of Pressure

BASE COURSE
- Character, Type
- Thickness
- Materials
- Cross Section

SURFACE
- Character
- Thickness
- Materials
- Cross Section
- Wear by Traffic
- Wear by Elements
- Impact of Traffic
- Tractive Resistance
- Wear of Tire
- Wear of Vehicle
- Dusting
- Influence of Locality

CROSS SECTION
- Width
- Crown
- Shoulders
- Ditches

LOADS
- Static
- Impact
- Surface Integral as Effected by Design of Vehicle

DESIGN OF INTEGRAL SLAB
- Strength and Stiffness of
  - Solid
  - Precast
  - Cellular

VOLUME CHANGES
- Joints
- Shoving

REINFORCING
- Theory of
- Amount
- Kind
- Distribution
- Direction

DESIGN (VEHICLE)

DESIGN OF VEHICLE
- Power Gear Ratio
- Braking
- Etc.
- Etc.

EFFECT ON LOADS
- Sprung
- Unsprung
- Distribution

ECONOMY OF OPERATION AND MAINTENANCE (See Automotive Industry)
- Economic limit of size of truck in various situations
- Cost of truck transport (Schedule of elements)
- Economic limit of haul
- Cost accounting

SURFACE
- Tractive Effort
- Wear on Tires
- Loads

MAINTENANCE OF VEHICLE

ALIGNMENT
- Curves (Speed)
- Grades

CROSS SECTION
- Width
- Crown

SAFETY

CONSTRUCTION

MATERIALS
- Bituminous
- Non-Bituminous
- Fundamental Mechanical Properties
- Methods of Test
- Standard Tests
- Specification
- Preparation and Treatment (See Special List)
- Proportioning

MIXING
- Efficiency of Mixer
- Central Mixing Plants

PLACING

METHODS OF TESTING ROADS
- Instrument
- Cores

DESIGN OF EXPERIMENTAL ROADS

DRAINAGE (And Drainage Structures)

IMPACT ON BRIDGES (See Design)

REINFORCING (Handling and Placing)

INSPECTION

PLANT DESIGN AND CONTROL

COST ACCOUNTING

CONSTRUCTION CONTRACTS

(8) To study proportioning and use of bituminous materials.

(9) To study bonding of brick surfaces.

(10) To study volume changes and the means of meeting them.

(11) To study operations of concrete mixers.

(12) To study the organization and economics of construction plants.

(13) To study sand-clay, top-soil and gravel roads.

(14) To study cellular and other new types of paving.

There is apparently a widespread activity in highway research throughout the United States on the part of the U. S. Bureau of Public Roads, the U. S. Army, the state highway commissions, the universities and industrial organizations and an earnest desire to put highway construction on a scientific basis. The economic features are under critical examination by such organizations as the National Chamber of Commerce. We should be able to express quantitatively the results of a standardized economic survey of a road project, just as in the case of a water-power project, for instance, except for those imponderables, which, like social betterment and public policy, influence the conclusions so profoundly.

It is not too much to say that the situation is critical, and that the sooner those interested come to a basis of fact, the more assurance we will have that the public will not interrupt progress in providing for highway transport because of a general feeling of insecurity.

Authority to Order Water Main Moved

The Public Service Commission of Washington, in the case of a petition brought by the city of Yakima to compel the Pacific Power & Light Co. to substitute a metal for a wooden water main, prior to the proposed paving of the street, has ruled that it has no power to order such a change unless it "is necessary to enable the company to render safe, adequate, and efficient service at a reasonable cost to its patrons" (Public Utilities Reports, July 21; Rochester, N. Y.). The commission also ruled that it was without authority to order the city to move the wood water main to a location beneath the parking strip.

Long Howe-Truss Railway Spans Being Replaced

New Double-Deck Steel Bridge of Three 173½-Ft. Spans Being Built Over Allegheny by Baltimore & Ohio

WHAT are believed to be the longest Howe-truss spans carrying railway traffic in the eastern part of the United States, if not in the entire country, are being replaced by a new steel structure. Shown in Fig. 1 herewith, the present bridge of the Baltimore & Ohio R.R. over the Allegheny River at Foxburg, Pa., consisting of three spans 174 ft. 10 in. long center to center of end bearings. Double-deck steel spans of the general construction shown in Fig. 2 are being erected alongside, to be rolled to place. On Aug. 21 the east span was rolled in, displacing the corresponding old one, without interrupting the train schedule. They are designed for E-50 loading, have a length of 173½ ft. center to center of end pins, are 23 ft. deep between chord centers and consist each of eight web panels.

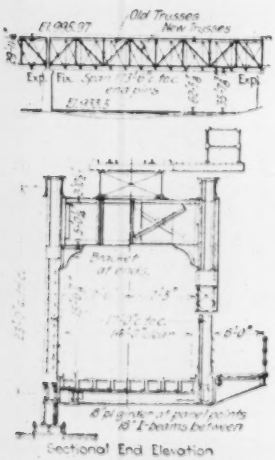


FIG. 2. CROSS-SECTION OF NEW FOXBURG BRIDGE

Originally the Foxburg bridge carried a narrow-gage line of the Pittsburgh & Western R.R.; it was built in 1872 and consisted of three double-deck timber Howe trusses, with the railroad on the top chord and the highway on the bottom chord. It was reconstructed, of similar type, in 1908. Four years later, when the line was changed to standard gage, it was necessary to provide increased carrying capacity, and the timber bottom chord was replaced by four lines of 12-in. 40-lb. I-beams. Until last year the bridge was used by the railroad on a toll basis. The railroad purchased the bridge in 1920 and plans were made for the replacement. Work is now being carried out by the Bethlehem Steel Bridge Co., with J. F. Ritter in charge on the ground. For the railroad, construction is under H. A. Lane, chief engineer, and is under the immediate supervision of P. G. Lang, Jr., engineer of bridges, field work being in charge of A. C. Clarke, district engineer.

Court Gives City Right to Take Utility Properties

A DECISION affecting the right of municipalities in acquiring properties of public utilities by eminent domain proceedings was recently handed down by the U. S. District Court for the Northern District of California, Southern Division. The case was that of the City of Los Angeles vs. The Southern Sierras Power Co. and the ruling of the court, applying the theory of higher use, allows the city to take certain of the company's hydro-electric properties over the protest of the company. The company has appealed to the U. S. Circuit Court of Appeals by a suit for a writ of error. A resume of the case as prepared by one of the company's engineers follows:

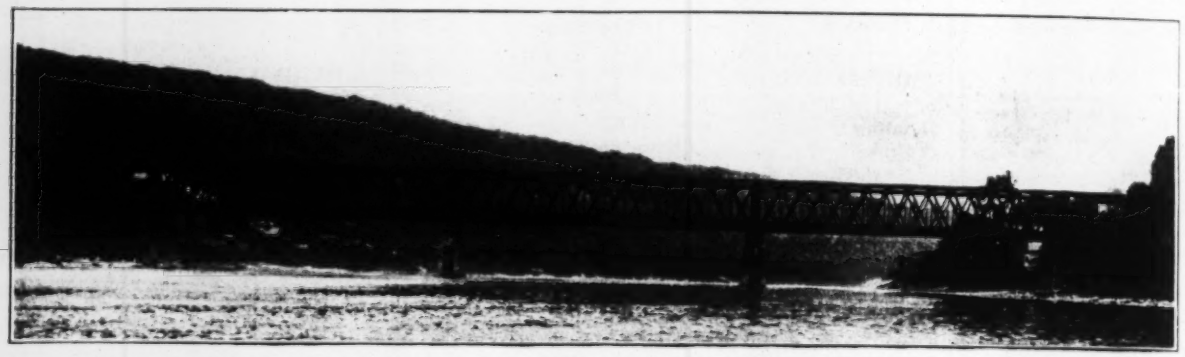


FIG. 1. DOUBLE-DECK HOWE-TRUSS BRIDGE CARRYING RAILWAY TRAFFIC

The Southern Sierras Power Co. is a public utility corporation operating under the jurisdiction of the California Railroad Commission. For many years it has generated and supplied hydro-electric power to seven counties in the southwest portion of the state, many sections of which are dependent upon this company as the only available source of hydro-electric power. The combined system of The Southern Sierras Power Co. and its related company, The Nevada California Power Co., includes eight hydro-electric generating plants and about 800 miles of high tension lines. No part of the system, however, comes within 40 miles of the city of Los Angeles, nor is the company's service devoted to the Los Angeles district.

The Southern Sierras Power Co. acquired from the Mono Power Co. 320 acres of land through which the Owens River flows in the so-called Owens River Gorge. In crossing this parcel of land, the stream drops 421 ft., thus affording a favorable opportunity for the development of hydro-electric power. Immediately upon acquiring the property the company began the construction of a power plant to be added to its existing generating and transmission system. Subsequent to this the city of Los Angeles instituted proceedings in eminent domain to secure the right to all of the water flowing through the 320 acres of land purchased from the Mono Power Co., together with a right of way for a tunnel through that property. The city had conflicting plans for development which would completely by-pass the company's plant. The property in question is located more than 300 miles from the city of Los Angeles and is more remote than are many other units of a comprehensive power development plan proposed by the city which includes unfinished power plants along the Los Angeles aqueduct.

The court refused to consider evidence of the service rendered by the company, the absolute dependence upon it for service of certain cities and communities or its relation to these cities and communities as an agent, with rates and service governed by the State Railroad Commission, but interpreted a California statute as holding the demands of a municipal corporation superior to that of any public service corporation, regardless of the service rendered by the latter and regardless of the necessities of the consumers dependent upon that utility. The court gave the city full power to exercise the right of eminent domain and instructed the jury to disregard the value of the plant, most of which had been constructed after the beginning of the legal action, when placing a value on the condemned property. This latter point was contested because the suit was not brought to trial within one year, as required by statute. Under these instructions, the jury made an award of $525,000. The case is now awaiting a hearing before the higher court.

Boards of supervisors of three counties, representing the major portion of the area where the company is selling the power in question, have instructed their district attorneys to enter appearance proceedings before the higher court and will endeavor to show that the counties would suffer if the company on whom they depend were to be deprived of the power rights in question.

Automatic Features of New Kern River Power Plant

Reaction Turbines for 810-Ft. Head Have Quickly Changeable Runners—Extensive Automatic Control Equipment

THE recently completed Kern River No. 3 hydroelectric plant of the Southern California Edison Co., is subject to such wide variations in stream flow and power demand that an unusual number of automatic features were considered necessary to insure its continuously efficient operation. Two 25,000-hp. Francis turbines are installed, operating under a static head of 810 ft., which is said to be the highest head ever used on reaction turbines. The plant was started up April 1 and has been in service continuously since that date.

The load requirements of the Southern California Edison Co., make it necessary for the plant to be able to deliver 60-cycle current to the northern subsidiaries at times and at other times 50 cycle current to properties to the south. In order to make this possible the turbines are each provided with two runners, one to operate with highest efficiency at 500 r.p.m., which gives 50-cycle current and the other to operate at 600 r.p.m., giving 60-cycle current. In order to make practicable an arrangement of this sort the turbine was designed with a view to facilitating a quick change of runners. The entire internal part of either turbine is removable from below which obviates the necessity for disturbing either rotor or stator of the generator when dismantling the hydraulic part of the unit. During the test on the plant the runners were changed in 20 hours from the time the unit was taken off the line until it was in service again at different frequency.

The flow of the river is variable and as there are practically no storage facilities for equalizing, there are times when the available water quantity will be only about half the normal supply. Under such conditions the plan of operation at the plant contemplates that one of the turbines will be operated as a master unit at 60 cycles, while any surplus water will be delivered to the other unit which will at that time carry a block load at 50 cycles. The range in flow is expected to be from 300 to 600 sec.-ft. In order to use the flow, whatever it may be, to most advantage, automatic devices are arranged to control the turbine gates in accordance with the quantity of flow in the penstocks.

An automatic control of the wicket gates by means of an interconnection between the two turbine units is so arranged that any quantity of water not required by the 60-cycle unit during periods of regulation or changing load will be absorbed by the 50-cycle unit and thus delivered into the 50-cycle system without loss. In order to make a device of this sort suitable for operation at all seasons or periods of change in the water flow without loss of water, this automatic control has in it a device for resetting the load limit to suit flow changes.

A balanced pressure is automatically maintained on both sides of the turbine runners at all loads so that the duty on the vertical trust bearings which support the entire rotating element is safely controlled. The main shaft of the turbine is provided with a renewable wearing sleeve at the stuffing box and the sleeve has an automatic water circulation for cooling purposes. The guide vanes are counterbalanced to prevent undue wear on the lower throat liner. Any seepage is automatically removed by ejectors.

An automatic pilot valve control is provided on each of the governors so that each entire unit can be completely shut down by simply pressing a push button on the switchboard. The pilot valve itself has a diameter of only ⅜ in. and is thus easily controlled by a push button similar to the ordinary electric light switch. This pilot valve actuates relays which in turn set in operation in proper sequence the machinery for closing down the unit in just the way it would be done if these operations were done manually. The mechanical operation of this automatic control is said to be so simple and so satisfactory that although designed as an emergency and safety feature it is now ordinarily used as the preferred means of shutting down the unit.

The central oil pressure system is arranged to automatically provide any necessary make-up air in the pressure-accumulating tanks. The maximum oil pressure is automatically limited and while the oil pumps are ordinarily driven by electric motors these are so arranged that in the event of failure of the motors or if the current should go off, a small water wheel automatically takes on the pump load and continues to carry it until the motors are again put in operation.

The hydraulic equipment was supplied by the Pelton Water Wheel Co.

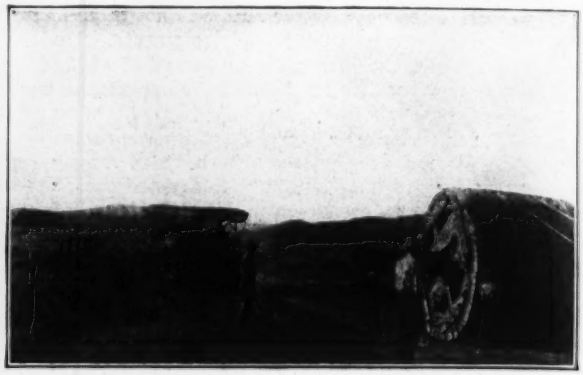
Quick Replacement of Bridge

According to a description in the *Baltimore & Ohio Magazine*, a three-span double-track bridge on the Washington branch of the Baltimore & Ohio R.R. was recently replaced by a new structure with only 5 min. interruption to traffic. The rolling method of replacement was used, the new structure being erected on falsework alongside and rolled over into position as the old structure was rolled out. The total moving weight in the rolling operation was 350 tons, and the actual time of rolling is stated as 3 min. 30 sec.

65-Ton Rotor Rolled More Easily Than Carried

Comparison of Methods of Moving Heavy Rotors Becomes Possible in Making Delivery to California Plants

IN DELIVERING machinery to San Francisquito power house No. 2 on the Los Angeles aqueduct it was necessary to make the final 10 miles of the journey over roads on which the grades range up to 10 per cent on both up and downhill. The most difficult part of the delivery problem was moving the 65-ton rotors for the two generators. The first rotor was taken in on a specially constructed trailer; the second rotor was lagged and rolled along the road, being handled in that way more easily and with a smaller crew and less power. Both methods required ten days in which to make the trip.



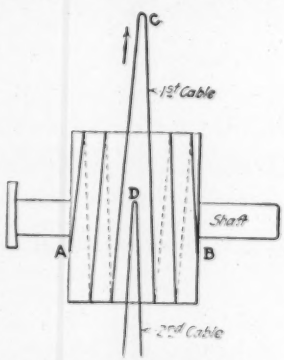
TWO 65-TON ROTORS MOVED BY DIFFERENT METHODS OVER THE SAME ROAD
At left, two tractors and seven trucks pulling rotor on special trailer. At right, duplicate rotor being rolled along by one tractor.

For transporting the first rotor a 50-ton trailer was used in connection with two dollies, an I-beam support being provided to distribute the load as uniformly as possible. With this rig the tractive effort required was very great, the ordinary requirements being two tractors and about seven motor trucks, each with a ballast load of one ton. There was, also, considerable difficulty in negotiating the turns and several break-downs of the trailers occurred when load concentrated on certain points. In bringing in the second rotor only one tractor was used ordinarily, although a second was kept in attendance to aid in holding back on down-grades and in "cutting" the load on turns. Both tractors were rated at 75 hp.

In order to protect the rotor that was rolled from damage in transit a lagging of 8 x 8 in. timber was placed around it and fastened by 8 iron bands placed like hoops on a barrel. These bands were not continuous, the two ends of each band being led to a depression in the lagging where they were connected by a bolt so placed that turning the nut would tighten up the band. The lagging was made long enough to project over each end of the rotor so as to give bearing on a wooden spider or head built up of heavy timbers. This head fitted just inside the lagging as a barrel head fits inside the staves and served as an aid in distributing the stress and preventing the lagging from shifting. The shaft of the rotor was similarly protected by lagging of a lighter weight.

The rotor was rolled by means of a double line of ¾-in. cable; two cables, each 750 ft. long being used alternately. Before starting the first of these cables was put on the rotor in the manner shown in the sketch, that is, with the loop *C* at the middle where the tractor could take hold and the cable wound around the rotor with the ends, *A* and *B*, fastened to eye-bolts sunk in recesses in the lagging.

As the first cable was unrolled, the middle loop of the second cable which was attached to an eye-bolt sunk in the lagging at the middle of the cylinder (*B*, in the sketch,) was wound on in its place. The only time lost for each 375 ft. of progress was in dragging back the unwound cable. While this was being done the ends of the cable which had just been wound on were fastened and the tractor was backed up for a new hold at the point marked *D* in the sketch. A team of horses was used for pulling the cable back, the horses dragging a sled to which a spacer was fastened for keeping the two ends of the cable separate. As the sled dragged from the ends of the free cable as the rotor was being rolled, a desirable tension was caused in the cable which was guided by hand into place on the rotor.



METHOD OF PLACING LINES ON ROTOR

The "cutting" or changing the direction in which the rotor was rolling was first done by a block and tackle while the rotor was standing still, a tractor being used for motive power. This method was slow and damaged the lagging. It was soon found that the standby tractor could easily cut the rotor while it was in motion by pulling on a sling about one end of the shaft, thus effecting the desired turn without delaying progress.

F. C. Sharrow Made Bolt Bearing Tests

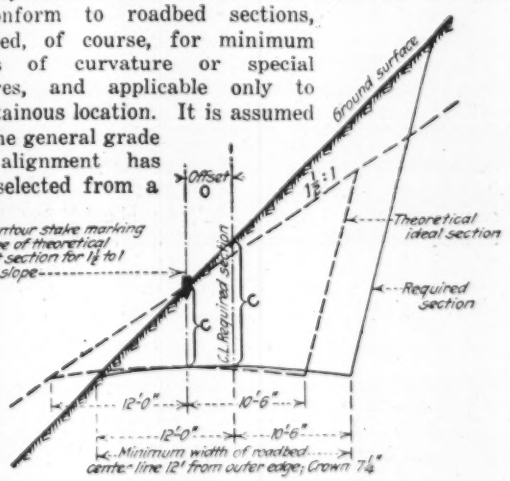
By an inexplicable typographic mix-up F. C. Sharrow, structural engineer, H. M. Lane Co., Detroit, Mich., was not given credit for the authorship of his article "Test Bearing Strength of Bolts Through Concrete Beam," in *Engineering News-Record*, Sept. 8, 1921, p. 413. The name of S. C. Majumdar was erroneously subscribed to the article as author.

Locating Highway Grades in Steep Side-Hill Country

BY GEORGE A. TILTON, JR.
San Luis Obispo, Cal.

FIELD LOCATION of highway alignment in steep sidehill country where the topography is broken, requiring short radius curves and frequent maximum grades, is usually confined to the survey of an angle line with sufficient topography to permit a paper location to be made in the office. Where the ground slopes are steeper than the maximum fill slopes, the roadbed must be in solid-cut or an equivalent section. To locate a center line in the field that will give solid-cut sections without excessive excavation or walls requires considerable more detail than usual in the field.

This discussion is intended to illustrate a method whereby the final center line can be located in the field to conform to roadbed sections, modified, of course, for minimum radius of curvature or special features, and applicable only to mountainous location. It is assumed that the general grade and alignment has been selected from a reconnaissance survey and the field location confined to fixing of a final center line and grade.



OFFSETS FOR SETTING OUTSIDE HILL GRADES

Slope of Ground		Cut "C"	Offset "O"	
24°	2.25 to 1	4.7′	6.0′	Downhill
26°	2.05 to 1	5.2	4.4′	Downhill
28°	1.88 to 1	5.8	3.1	Downhill
30°	1.73 to 1	6.3′	1.9	Downhill
33° 41′	1.50 to 1	7.4′	0	
36°	1.38 to 1	8.1′	1.0	Uphill
38°	1.28 to 1	8.8′	1.8	Uphill
40°	1.19 to 1	9.5′	2.5′	Uphill
42°	1.11 to 1	10.2′	3.1	Uphill
44°	1.04 to 1	11.0′	3.7	Uphill
45°	1 [illegible] to 1	11.4′	4.0′	Uphill
46°	0.97 to 1	11.8′	4.3′	Uphill
48°	0.90 to 1	12.7′	4.8′	Uphill
50°	0.84 to 1	13.7′	5.3	Uphill
55°	0.70 to 1	16.5	6.4	Uphill
60°	0.58 to 1	20.2′	7.4′	Uphill

The most important and difficult case arising in location is where the grade is maximum and controls the alignment. If the maximum grade is over five or six stations in length some accurate method must be used to select the center line, so that solid-cut sections, with minimum excavation, will result. The same also applies to any other grade where it is desired to maintain it uniformly for any considerable distance.

To locate alignment in connecting with a grade, some sort of a grade contour must be used as a guide in the selection of curves and tangents. The more accurate the grade-contour is established, the more accurate will the alignment result (in respect to minimum excavation).

For grades less than the maximum, a hand level or clinometer can be used satisfactorily to establish a grade-contour but in the case of a maximum grade it should be traced with a transit, the vertical arc of which should be set to the grade angle. This angle should be about 0.10 per cent less than the desired grade in order to allow for nominal shortening of the grade contour length. However, if a clinometer is used in tracing a grade contour approaching the maximum, as much as 0.50 per cent less grade should be used.

Beginning at the highest control of the grade, the trace of the grade contour should be marked on the ground at short intervals, such as the approximate P. C., I. T. and P. T. of curves, besides all important grade contour deviations. The transit can be set up quickly over each point (without a plumb-bob) and by means of an H. I. rod the grade-contour can be progressively traced for an accurate guide to a final center line. In places where the line crosses a ravine, or other places where a shortening of the grade contour distance is anticipated a still further flattening of the grade-angle should be made.

A three man party can stake about 1½ miles of grade contour in open country and from ½ to ¾ of a mile in brushy country in one day—stakes only set temporarily for a guide.

For actual selection of the final centerline, horizontal offsets are made from the grade contour stakes which are assumed to mark the center line of a theoretical cross-section in full width and a solid-cut section of minimum excavation for a 1½ to 1 ground slope. If a stretch of grade consisted of 1½ to 1 ground slopes, the grade contour as traced could be used and fitted for a center line. Where the slopes are constantly changing, however, offsets must be made in order to bring the roadbed in solid-cut for the steeper ground slope. Take for example the case of a 1½ to 1 ground slope in transition to a 1 to 1 ground slope. In referring to the accompanying table and sketch, it is seen that a horizontal offset must be made uphill of 4.0 feet. In the case of a transition to a flatter slope than 1½ to 1 such as a 24° slope, an offset of 6.0 feet horizontally must be made downhill from the grade contour (assuming solid-cut).

Having flagged out a center line by means of the offsets to a grade contour described above, the curves can be readily fitted, either by the external distance or long-chord, or in the case of reversing and compounding curves, by the sub-tangent. In dense underbrush where a grade contour line has been brushed out the trial deflection method becomes economical in saving excessive brushing.

The centerline selected by this method results in a definite grade and alignment from which little change is required to avoid unnecessary excavation or excessive walls, thus eliminating an office location.

Two Words Give Full Data for Mapping Lake

In the present official map of California Tulare Lake is shown as covering 153 sq.mi. Much of this area has been reclaimed and brought under cultivation so the Railroad Commission, in preparing a new map, wrote to Roy May, county surveyor of Kings County, in which the lake is located, asking him to furnish the commission with a township map showing the present water boundary of the lake. May returned the commission's letter with the laconic marginal notation: "Plumb dry."

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Getting the Full Value of Engineering Periodicals

BY PERRY THOMPSON
Sanitary Engineer, Yonkers, N. Y.

I was astonished to learn recently how many of my young engineering friends were not regularly reading *Engineering News-Record* nor other similar periodicals because (1) they were "too busy"; (2) the issues accumulated too fast and occupied too much space; (3) it was difficult to locate articles in back numbers before the index came along, and sometimes even then; (4) the cost seemed large for the few articles of special interest. To them and to others who think likewise but who do read some copies and may read this, I would like to give the benefit of my experience with six technical periodicals:

(1) *Time for Reading*—I doubt if any of my friends are more busy than I, yet I not only find time to read technical papers but clip newspaper and magazine articles occasionally as well. There is much in knowing how. One should not attempt to read every article regardless of whether it is in his special line or not, and perhaps not even then, but he should know there are such and such articles and be able to turn to them later should it then become desirable. An easy and satisfactory way of doing this will be mentioned later.

(2) *As to Occupying Space*—It is indeed true that technical journals occupy space if they are filed just as they come to hand, but this is not necessary. An easy way to reduce their size, if one is interested in the technical articles only, is to open the wire fasteners under the back cover, straighten them with a pair of pliers, file the square edges off their points with a small flat file and then pull off the pages of advertising on that side. Turning the issue over, insert a small screwdriver under the center of the fasteners and extract them. Now remove the index sheet and the pages of advertising on this side, then remove the part containing the articles to be kept, and after placing the index sheet in front put back the fasteners and clamp them with the pliers. Only three small tools and three minutes are necessary.

(3) *Finding Articles Easily at Any Time*—I index the periodicals as they arrive, either as I read them or preferably before, turning down the corners of specially interesting articles for easy identification later, as well as to save time in looking for them again. The index need not be elaborate unless one is specializing along several lines. My index has 20 subjects subdivided; water supply has 70 subdivisions and sewage disposal has forty-five. A card index is most satisfactory, especially if intended to be permanent, but a loose-leaf index will do.

At this point someone will say "too much system," but it does not work out that way, for with very little practice one unconsciously learns his headings or subjects by heart, and knows almost instantly the one most suited to the article, although it is often advisable to index an article under two or more headings. The latter can often be determined only by reading, and would therefore be omitted if left to a subordinate who did not read them.

And then there is the additional advantage that one's own system is likely to be best suited to his needs; but if this should not be so it will at least serve till the printed index arrives. Still another advantage is that one can index an article he may not have time to read, nor any use for just then, but which he might read hurriedly and try to remember if he had no index; the chances being he would hardly absorb it, to say nothing of remembering it.

(4) *Cost*—If one picks out at the end of the year the articles which bear directly on subjects in his special line and applies to them the total cost of the volume, it may seem he has paid well for them; but when he remembers that he is getting later ideas than he can find in any book, and indeed many thoughts he cannot find in books at all, he should feel that he cannot hope to keep abreast of the times and dispense with engineering periodicals; in other words, he should feel that he cannot afford not to take them.

Improved But Still Deficient

THE ENGINEERING INDEX, 1920—New York City: The American Society of Mechanical Engineers. Cloth; 6 x 9 in.; pp. 586; $6.

Although the present issue of this well-known annual is an improvement over the previous one, just as that was better than still earlier issues, yet the present volume leaves much to be desired both in the way of completeness and classification. The deficiencies in classification may be due to the fact that the several index entries are prepared for monthly publication and thus get what might be called a permanent set month by month, instead of remaining in a fluid form suitable for easy, systematic classification for the yearly volume.

However this may be, the fact remains that the classification—or at least the distribution of many of the entries under the various dictionary headings—is very irrational. This is particularly noticeable in the case of a number of references to water treatment. These are found distributed in a rather haphazard way under two or more of the dictionary headings. To be still more specific, articles on mechanical filters or filtration are entered under: filters; filters, sand; filtration plants; water; and water filtration. Two articles on cleaning sand in the St. Louis water filters, appearing in two different journals, are entered, one under filters, subhead cleaning sand, and the other under filtration plants, subhead cleaning filters.

The same general line of criticism might be applied to the entries under many other topics. Much improvement could readily be made by cutting a considerable number of the dictionary classifications to mere cross references and by a more careful scrutiny of the articles to see where they really belong.

Criticism as to omissions falls under two main heads: (1) Many important articles published during the year

covered are omitted entirely; (2) in the case of abstracts or reprints of society and other papers or articles on the same general subject appearing in two or more journals, the practice is to enter only one.

Taking up the second point first, it may be noted that while bulk and cost may go heavily against duplication of entries, yet it must be remembered that an index that is intended for universal use will go into the hands of one engineers who has one journal and of another with still another, and so on, and that the very nature of engineering work is such that many engineers have access to only one or at most two journals. Therefore, to be of the greatest use to the greatest number, there should be entries—not full summaries in every case—for all the journals, society proceedings, etc., in which an article on a given subject can be found either in its full, original shape, or in substantial abstract.

As to complete omissions of important articles, many such have been noted in the civil engineering field. These cannot be due to space limitations, for under the same subject and from the same journal, at least in the case of *Engineering News-Record*, minor articles are listed and major articles omitted.

A Bird's-Eye View

ECONOMIC DEVELOPMENT OF THE UNITED STATES—By Isaac Lippincott, Ph.D., Professor of Economic Resources, Washington, University. New York and London: D. Appleton & Co. Cloth; 5x8 in.; pp. 691. $3.50.

By four periods of time the author reviews the economic history of the United States down to the present time. He outlines the growth of population, agriculture, manufactures, commerce, railroads, banking and labor organizations. With so comprehensive a program much of the treatment is necessarily sketchy, but for students and others approaching the general subject for the first time—and for these the book is written—the work promises to serve its purpose.

Government Control During the War

GOVERNMENT CONTROL AND OPERATION OF INDUSTRY IN GREAT BRITAIN AND THE UNITED STATES DURING THE WORLD WAR—By Charles Whiting Baker, C. E., Consulting Engineer. New York: Oxford University Press. Paper; 7 x 10 in.; pp. 138. $1.

In this monograph the author has presented a broad, general survey of what Great Britain and the United States did in the way of government control and operation during the recent war. After a few introductory pages, in which, among other things, government efficiency is discussed, consideration is given to railways, public utilities (United States), shipping, labor, capital food, and fuel. In a chapter on "The Popular Verdict and the Truth," the author holds that conservative opinion condemns while the popular verdict approves the results of government control. Elsewhere it is maintained that the extension of government control in the future is inevitable. In a chapter on "Conflict Between the Executive and Legislative Branches of Government" it is urged that our state and national legislatures go altogether too far in interfering with the proper duties of executive departments. Although emphasing the grave errors made in government control during the war, Mr. Baker in general holds that the main results were commendable, taking into account that in wartime efficiency is not to be judged by ordinary standards, but by the attainment of the desired end in the least possible time.

Street Railway Commission Report Digest

ANALYSIS OF THE ELECTRIC RAILWAY PROBLEM: Report to the Federal Electric Railways Commission with Summary and Recommendations, Supplemented by Special Studies of Local Transportation Issues in the State of New Jersey and the City of Denver; with Notes on Recent Developments in the Electric Railway Field—By Delos F. Wilcox, Ph.D., Consulting Franchise and Public Utility Expert, Chief of the Bureau of Franchises of the Public Service Commission for the First District, State of New York, 1907-1913; Deputy Commissioner of the Department of Water Supply, Gas and Electricity, City of New York, 1914-1918. New York: The Author, 73 Gleans St., Elmhurst, L. I. Cloth; 7 x 10 in.; pp. 789; $10 net.

In publishing privately his analysis of the testimony on the financial troubles of the street railways, taken by the Federal Electric Railway Commission in 1919-20, and his suggestions as to the report of the commission, Mr. Wilcox has made available what the commission itself characterized in its report as "a complete and masterful study of the whole electric railway problem."

Mr. Wilcox's method is to analyze and discuss the testimony under topical heads, designed to show the plight of the street railways, its cause and the remedy, always bearing in mind the three great parties in interest, riders, employees and investors, and also taking into account the taxpayers and the public as a whole. This plan leads him to consider at the very outset the street railway as an essential public industry, its capital requirements and why its credit has been lost. Under lost credit, Mr. Wilcox discusses overcapitalization, neglect to amortize both excess capitalization and accrued depreciation, payment of unearned dividends, overbuilding, holding companies and banker control and the uniform 5-cent fare are discussed. After going over many other phases of the subject, including public regulation, jitney competition, labor problems, the depreciated dollar, zone fares, public subsidies, etc., valuation and rate problems are taken up at some length. Toward the end, the author presents four choices: (1) Abandonment of public interest in the street railway industry, which he declares is no remedy; (2) more complete commission regulation, which he characterizes as inadequate; (3) service at cost, which "falls short"; (4) public ownership and operation, which he considers to be "the ultimate solution." The whole case is then summarized under 54 heads, after which the appendices mentioned in the sub-title, as given above, and a detailed index close the volume.

How far the author's conclusions go beyond the recommendations of the commission may be inferred from the foregoing outline taken in conjunction with the commission's recommendations, as printed in *Engineering News-Record*, Sept. 2, 1920, p. 480; but it should be noted that in many respects there is general agreement between the two. The digest partakes largely of the nature of a brief for the public, but always with an honest attempt to consider all the parties in interest. Mr. Wilcox's forceful expression of his own opinions—very properly, since they were virtually requested by the commission—conform with his very decided personal views, based on long and close study.

Unquestionably, Mr. Wilcox has rendered a distinct public service: First in his exhaustive analysis of a vast mass of testimony; second, in his own discussion of principles, practice and experience; and third, in publishing privately what the commission found itself unable to publish and what the American Street Railway Association—which published and distributed at its own expense the testimony and the commission's report—was unwilling to print.

Irrigation and Other Eastern Engineering

REVIEWED BY F. W. HANNA

General Manager, Canada Land & Irrigation Co., Ltd., Medicine Hat, Alta.

NOTES ON IRRIGATION, ROADS AND BUILDINGS AND ON THE WATER SUPPLY OF TOWNS—By William Lumisden Strange, M.Inst.C.E., Chief Engineer in Sind (Retired); Author of Indian-Storage Reservoirs with Earthen Dams. New York: E. P. Dutton & Co. London: George Routledge & Sons, Ltd. Cloth; 8x9 in.; pp. 849; over 200 illustrations. $18 net.

Mr. Strange has brought together in this book notes kept by him during some 30 years of Government engineering experience in India, Ceylon and the Transvaal. As the title indicates, the author has included under one cover information on the subject of irrigation, roads and buildings, and in addition thereto information on town water supplies. The inclusion of so many slightly related subjects in one book is an unusual procedure and one not wholly commendatory except as affording a view of the broad and valuable experience of the life work of a worthy engineer.

As might be expected in the treatment of divergent subjects in a single book, the discussion is unevenly divided among them. Fortunately for the general reader, however, Irrigation (558 pp.), and Town Water supply (147 pp.), have received the bulk of the author's attention. The chapter on Roads (148 pp.) and District Buildings (44 pp.) may be dismissed with the remark that although the author displays a keen knowledge of general road building and architectural principles the material he presents is so localized as to be of benefit mainly to practitioners in the particular districts in which the author has gained his experience. The section on Town Water Supply gives a condensed but comprehensive and readable consideration of the subject but the reader who is seeking for technical help on water supply problems will have to look elsewhere.

The whole subject of Irrigation is treated in a concise manner by summarizing and tabulating principles and facts and supplementing them with brief discussions. There is little technical detail or mathematical consideration, so the careful reader can make rapid progress in grasping the subject matter. The first four chapters on Irrigation deal with definitions of terms, water supply, uses and losses and miscellaneous matters, and the next four with storage reservoirs, dams and outlet works. There are ten chapters on the construction of canals and their accessories on alluvial soils and on the physics and control of large Indian rivers on these soils; one chapter on distributary systems and one on irrigation laws, finance and administration.

In the main the irrigation practice advocated, subject to modifications to meet local conditions, agrees quite well with American practice. Some differences worthy of notice are the narrowness of top widths of earth dams and the use of heavy masonry canal structures to the complete exclusion of reinforced concrete.

The author deserves commendation for his logical, concise and forceful style, for his carefully collected and arranged subject headings and for a good index. The book as a whole is worth reading.

Cloth Bound, Not Paper; Correction

By mischance, the binding of Hering and Greeley's 'Collection and Disposal of Municipal Refuse" was given as being of paper instead of cloth in the review appearing in these columns on July 21, p. 115.

PUBLICATIONS RECEIVED

ANNALI UTILIZZAZIONE DELLE ACQUE—IDROGRAFIA CONCESSIONI DI ACQUE PUBBLICHE; Vol. III, 1920 (Monografie, Studi, Legislazione, Statistiche, Recensioni, Idrografia, Notiziario)—Rome, Italy: Ministero Dei Lavori Pubblici. Paper; 7 x 10 in.; pp. 186; illustrated. L. 10.00.
Contains papers by Camillo Duidi, Giuseppe Albenga, Carlo Bonomi, Luigi Kambo, statistics, list of concessions, etc.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS—Transactions, Vol. XIII—Part I, 1920—New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 463; illustrated. $6.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS—Proceedings, 1920—Valparaiso, Ind.: Charles Carroll Brown, Secretary. Cloth; 6 x 9 in.; pp. 464; illustrated. $5.

ANALYTICAL GEOMETRY: A First Course in Plane and Solid with Numerous Examples—By Charles N. Schmall, B.A., Instructor in Mathematics in the Public Schools of New York. Second Edition, Enlarged. New York: D. Van Nostrand Co. Cloth; 5 x 8 in.; pp. 338; illustrated. $1.75.

BRICK: How to Build and Estimate; A Presentation of Facts for Prospective Owners of Houses and Other Buildings and a Manual of Construction Data on Brickwork for Architects, Engineers, Contractors and Builders. By William Carver, Architect. Revised and Enlarged. Cleveland, Ohio: The Common Brick Manufacturers' Association of America. 25c.
Besides serving as a brief and describing the "new ideal wall," this pamphlet contains much useful information for brick users, including many illustrations.

CANAL STATISTICS, 1920: Prepared in Collaboration with the Department of Railways and Canals, Canada—Ottawa, Can.: Dominion Bureau of Statistics. Paper; 7 x 10 in.; pp. 51.

CHEMICAL AND BIOLOGICAL SURVEY OF THE WATERS OF ILLINOIS: Report, 1918-19, Issued by Edward Bartow, Chief, Division of State Water Survey, Department of Registration and Education, Urbana, Ill. Paper; 6 x 9 in.; pp. 280; illustrated.
Reports of special investigations and several theses submitted to the faculties of the University of Illinois, in addition to report of work of survey, are included. Equipment for a small waterworks laboratory is enumerated.

DIGEST-INDEX OF THE FEDERAL WATER POWER LAW AND REGULATIONS THEREUNDER—By M. O. Leighton, M. Am. Soc. C.E., M. Am. Soc. M.E. Washington, D. C.: M. O. Leighton & Co. Paper; 6 x 9 in.; pp. 19.

EFFECTS ON CONCRETE OF IMMERSION IN BOILING WATER AND OVEN DRYING—By W. J. Schlick. Ames, Iowa: Engineering Experiment Station, Iowa State College of Agriculture and Mechanic Arts. Paper; 6 x 9 in.; pp. 21; illustrated.

FARM BLACKSMITHING: A Textbook and Problem Book for Students in Agricultural Schools and Colleges, Technical Schools, and for Farmers—By John F. Friese, Head of the Machine Shop and Forging Departments, Technical High School, St. Cloud, Minn. Peoria, Ill.: The Manual Arts Press. Cloth; 5 x 8 in.; pp. 92; illustrated. $1.25.

GRAPHIC PRODUCTION CONTROL—By C. E. Knoeppel, Member Society of Industrial Engineers, M. A. S. M. E.; Assisted by Various Members of the Author's Firm and Staff. New York: The Engineering Magazine Co. Cloth; 6 x 9 in.; pp. 477; illustrated. $10.

HIGHWAY RESEARCH PERTAINING TO CONCRETE ROADS: Sections and Details of Test Highway as Constructed at Pittsburg, Cal. Preliminary Report, July, 1921. Inaugurated by the Columbia Steel Co., San Francisco, Cal.: The Company. Paper; 7 x 10 in.; pp. 20; illustrated.
One page of text outlines the test highway, on which a motor-truck test to destruction was to begin Sept. 1. Thirteen types of construction are figured.

HIGHWAY RESEARCH PERTAINING TO CONCRETE ROADS: Sections and Details of Test Highway As Constructed at Pittsburg, Cal.; Preliminary Report, July, 1921. Inaugurated by Columbia Steel Co., San Francisco, Cal. Paper; 7 x 10 in.; pp. 20.
An article on these tests appeared in *Engineering News-Record*, Aug. 18, 1921, p. 276.

INERNATIONAL ASSOCIATION OF INDUSTRIAL ACCIDENT BOARDS AND COMMISSIONS: Proceedings, 1920—Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 447.

THE NEW INTERNATIONAL YEAR BOOK: A Compendium of the World's Progress, 1920—By Frank Moore Colby, M. A. New York. Dodd, Mead & Co. Cloth; 7 x 10 in.; pp. 775; illustrated. $6.75.

ONE-HINGED STEEL ARCH: An Investigation and Its Comparison with Other Types; A Thesis Presented to the Faculty of the Graduate School, Cornell University, for the Degree of Doctor of Philosophy by Nee Sun Koo, B.S., M.C.E., McGraw Fellow in Civil Engineering, 1920-21. Reprinted from the Cornell Civil Engineer, Mar., Apr., May, 1921. New York: The Author, 408 W. 115th St. Paper; 9 x 12 in.; pp. 18, illustrated.

OIL FLOW IN PIPE LINES: Comprising Charts Showing the Pressure Loss in Different Sized Pipe Lines, the Conversion of Viscometer Readings, the Horse Power Required for Pumping. San Francisco, Cal.: King Knight Co. Paper; 12 x 9 in.; pp. 12. $3.

PROVIDENCE CITY PLAN COMMISSION: Reports, 1915-20—Providence, R. I.: The Commission. Paper; 6 x 9 in.; 58; illustrated.

A REVIEW OF TEN YEARS' PROGRESS, 1910-20—By John W. S. McCullough, M.D., Chief Officer, Ontario Board of Health, Toronto. Paper; 7 x 10 in.; pp. 48; illustrated.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Humanizing Engineering Societies

Sir—May I express my pleasure at reading the very refreshing words on page 346 of your issue of Sept. 1, under the caption "Honoring Honorary Members?" The concluding sentence correctly expresses a condition which should be changed, as it would be for the better, and more in keeping with the modern attitude toward others in all industrial concerns aiming at the best results. While the honor conferred in such cases is really mutual, it is no more than fair to the individual to make it marked by more than a plain statement of a vote recorded.

Recently in the Boston Society of Civil Engineers a member for some years on the honorary list was asked to address the society on his seventy-fifth anniversary, and there has lately been a feeling among the members that there should be a larger sense of responsibility toward the older members, who for various reasons find it difficult to maintain themselves after passing the age of seventy. In a large society it may be less easy to perform such acts of courtesy but it is certainly worth the trying.

There is no class of men on earth more friendly than engineers, when once the skin is pierced, but they sometimes require a little prodding to see the necessity for a change in program.

FREDERIC I. WINSLOW,
Consulting Engineer.

Framingham, Mass., Sept. 5.

Am. Soc. C. E. Constitution Again

Sir—A careful reading of the revised constitution of the Am. Soc. C. E. will discover few sections that improve upon the old ones, some that will be much more cumbersome to administer, one that is either meaningless or unworkable, and one that appears to contravene the New York State law.

The provision for the allotment of funds to local sections, which is the chief concession to the twice-expressed wishes of a majority of the society's voters, proves to be permissive rather than mandatory, and therefore adds nothing to the powers of the Board of Direction which has now as much authority to allot funds to local sections as it has to pay traveling expenses to its own members.

Sections 9 and 10 of Article VII read in part:

"No count or listing of votes cast in any society canvass or election shall be permitted until after the polls are closed, and then only by the officially appointed committee of tellers. A voter may withdraw his ballot, and may substitute another at any time before the polls close."

"The polls shall close at 9 a.m. of the first day of the annual meeting," etc.

Just what does this mean? Is it intended that the ballots shall not be classified in any way as received? If so, how is a member's new vote to be substituted for his old one, and how long will it take the tellers to ascertain who of the voters are corporate members, and who of them are disqualified for non-payment of dues? If the votes be classified, is the information so obtained to be at the disposal of the secretary for the mutual advantage of himself and friends, or are all members to have equal access to it? Why was this substituted for the 25-year-old provision of the present constitution that, "The secretary shall make a list of the voters from whom ballots are received, which list shall be open to inspection by all corporate members?"

Judging from Article VII, of the revised constitution, the committee considered the nomination and election of officers to be the prime function of the society, for not only are the members required to vote three times for each officer elected, but it is prescribed that "Every corporate member is expected" to occupy himself diligently, from "Not later than April 1 of each year" until the annual meeting in the following January, in the accomplishment of this paramount object.

It seems to the writer that in the development of this elaborate and expensive scheme which could only be desirable in a social club where the members are mutually acquainted, the committee unwittingly introduced a "joker" with the eleventh-hour amendment which they added at the Houston convention.

In Section 4, of Article VII, it is provided that "No vote of a corporate member for a nominee for director resident outside of the district in which the member resides, shall be counted." Whatever the intent may have been, the language seems clearly to apply to all ballots for nominees which must include the final vote that elects the nominee to be an officer. It is the writer's understanding that the New York statute under which the society is incorporated requires that *all corporate members shall have the privilege of voting for all elective officers.* If the tellers are required by the constitution to cast out the votes of those members who do not happen to live within the same district as the nominee for director will not the above provision of the law be therefore nullified?

In view of the above uncertainties it seems to the writer to be the part of wisdom to stand by the constitution that has well served us in the past, and vote "'No" on the revision.

GARDNER S. WILLIAMS.

Ann Arbor, Mich., Aug. 27, 1921.

[Copy of Major Williams' communication was transmitted to Peter Junkersfeld, of Boston, on Aug. 30, with the following letter from the editor:

"We cannot again permit the internal bickerings in the American Society of Civil Engineers to occupy a great deal of valuable space in *Engineering News-Record* and to crowd out important material awaiting publication. We will publish Major Williams' letter, but will permit only one reply thereto. That reply must not be longer than the protesting letter, and, since we do not want any marathon list of signers, it may be signed by only one name. Since you were chairman of the committee which drafted the proposed constitution, we think it proper to give you opportunity to write the answer."

Col. Junkersfield answers that since the committee on referred amendments completed its work and was discharged at Houston he does not wish to write a reply. He suggests, however, that answers to the criticisms may be found in two communications to members by the acting secretary of the society on March 19 and Aug. 3, 1921, the former including the comments of the committee on referred amendments and the latter the legal opinion of Parker & Aaron, counsel for the society.—EDITOR.]

Sir—An editorial in your issue of Aug. 18, 1921, expresses the opinion that the proposed revision of the constitution of the American Society of Civil Engineers should be adopted by an overwhelming vote.

The adoption of this proposed revision will increase the expenses of the society certainly more than $10,000, and will reduce the available funds possibly more than $23,500 for the year 1922; this increase in expense and curtailment in revenue can only be avoided thereafter by subsequent amendments to the constitution.

This decrease in available funds will result from increases in expense due to extra meetings of the Board of Direction and the excess cost of the proposed over the present method of nominating and electing officers, and the decrease in revenue due to failure to provide for the payment of dues by "members resident outside of North America" and by associates. This will produce a deficit for the year 1922, unless the technical activities of the society are seriously curtailed and the money usually allotted for publications is materially reduced.

Article IV of the proposed revision contains no provision for the payment of dues by members residing outside of North America. There is no provision for the transfer of the present associates to the grade of affiliates; nor is

there any provision for the payment of dues by the present associates.

Dues are payable in advance on Jan. 1 of each year. If the proposed revision of the constitution is adopted it could not be amended before April, 1922. There will be on Jan. 1, 1922, about 600 members who are resident outside of North America who would thus not be required to pay dues aggregating about $12,000, and 175 associates who would thus not be required to pay dues aggregating about $3,000, which amounts the society could not legally collect.

Article VII provides for a cumbersome method of electing officers whereby the services of the clerical forces of the society would be required for a considerable portion of the period beginning Jan. 1 and ending at the annual meeting over one year later. This method would cost the society annually for the necessary clerical help, printing, postage, etc., at least $1,000 more than the method prescribed by the present constitution.

Article VIII makes mandatory provision for six meetings of the Board of Direction each year. By reason of expense to the society and time required for western members to attend its meetings, the Board of Direction has usually met four times each year; and it is proposed to reduce these meetings to three each year. The cost of three meetings of the board for mileage of its members would be about $7,500; in addition there would be the extra cost of arranging for these meetings, of multigraphing and distributing the minutes of the meetings, and other necessary expenses.

The society would face a serious financial burden in the adoption of the proposed revision of the constitution, even should a large proportion of the members resident outside of North America and of the associates waive the absence of a constitutional obligation and pay their dues.

It would be reasonably certain, should the constitution be revised as proposed, and the revenue thereby decreased, that the technical activities of the society would need to be seriously curtailed and the allotment of funds to local sections indefinitely postponed, otherwise, unless the dues of members are raised to provide the necessary funds, there would be a deficit in the finances of the society.

The question naturally arises, "Does the society really need a revision of its present constitution at the expense of its technical activities and the stimulation of its local sections, and, are the debatable benefits of the proposed revision worth the increase in expenses involved?"

The society can function under its present constitution until a proper revision, which does not involve a large and unnecessary financial burden to the society, can be submitted.

There are other serious objections to fundamental provisions in the proposed revision but by reason of the above facts alone the writer is opposed to the adoption of the proposed revision of the constitution and will vote "No" on the ballot to be canvassed on Oct. 5, 1921.

Philadelphia, Sept. 2, 1921. RICHARD L. HUMPHREY.

[As in the case of Major Williams' letter only one reply to this communication will be printed. This letter also was submitted to Col. Junkersfeld, but he preferred not to engage in controversy.—EDITOR.]

How Can a Coral Strand Be Made Into a Bathing Beach?

Sir: We are interested in securing information on the formation of artifical bathing beaches. A portion of the shore line in question provides a fair bathing beach facing the Atlantic on the north shore of Porto Rico. Certain sections, however, directly in front of park property, are studded with coral rocks.

Information as to whether the dynamiting and removal of this coral rock would enable the natural formation of a bathing beach will be very greatly appreciated. We would particularly like to know from any of the contributors of the *Engineering News-Record* whether this has been done elsewhere and with what results.

W. CRYDER.
Gen. Supt. Ltg. Div.,
Porto Rico Railway Light & Power Co.
San Juan, P. R. Aug. 19.

Reasons for High Freight Rates on Brick

Sir:—The correspondence in the *Engineering News-Record*, Aug. 4, p. 205, from T. C. Powell, vice-president of the Erie R.R., and R. P. Stoddard, secretary-manager of the Common Brick Manufacturers Association, with reference to "Freight Rates as a Deterrent to Construction," has just come to my attention. Mr. Stoddard's letter confirms previous information to the effect that brick for building construction in the larger cities throughout the country are handled by rail but comparatively short distances from brick yards to city delivery tracks, perhaps five to ten miles, less frequently more, and in some cases from brick yards adjoining or inside the city limits.

High freight rates for this and similar commodities are justified by the fact that this traffic moves but short distances, and is handled over tracks and facilities in large congested cities, making the cost to handle enormously high. In many cities railroads have cost to exceed $1,000,000 a mile; costs up to $5,000,000 and more per mile of road are frequent, not including those portions used almost exclusively for passenger traffic. The Chicago, Milwaukee & St. Paul Ry. is now contesting the demand of a northwestern city for a plan of grade separation which would cost, in addition to the present high cost of the property, more than $12,000,000 for less than two miles of road, the principal traffic over which is freight. The ground area, track and driveways necessarily used for setting out but one car to be unloaded in a team yard will, in many cities, represent a value of $30,000, and not infrequently values as high as $75,000, or even $100,000. On many first-class railroads traffic from brick yards, gravel pits and stone crusher plants could be moved a hundred miles or more in a direction away from the city over tracks and other facilities, the cost of which would not be as great as that for one mile into the city.

The cost of handling freight in the busy and congested terminals of large cities is very great, many times more than for an equal distance in the country, and doubtless in many cases it costs as much time and money to handle a car one mile within the limits of a city railroad terminal as would be required to move it over an entire operating division. There are many reasons for this, the principal ones being the congestion of business, the short and slow movements, and the complications of classifying and bunching the business. There are doubtless many instances in which brick can be trucked thirty to fifty miles from the plant in less time and with less cost than would be involved in moving it one mile from the railroad team track in the city to the building site. Conditions which bring this about are fundamentally similar to those with which the railroads are confronted in moving traffic through the congested and complicated rail thoroughfares of a large city.

Should not freight rates for commodities moved short distances, requiring the use of expensive facilities and difficult and costly transportation service, bear some relation to the cost of the investment necessary for making the transportation possible? If bricks were made on the Island of Manhattan, or near the public square in Cleveland or the loop in Chicago, their cost would be very much increased; for very much the same reasons rail transportation costs in and through large cities must necessarily be very large. The Common Brick Manufacturers Association, as well as others, doubtless quite willingly pay a very much larger price for maintaining an office in Cleveland than would be paid in some small town, conceding the reasonableness of higher office expenses in the large city than in the small one. The same reasoning, I think, applies to the operations performed and the facilities furnished by a railroad in handling freight in the heart of a large city, especially such comparatively cheap, bulky and short-haul materials as common brick, sand and stone.

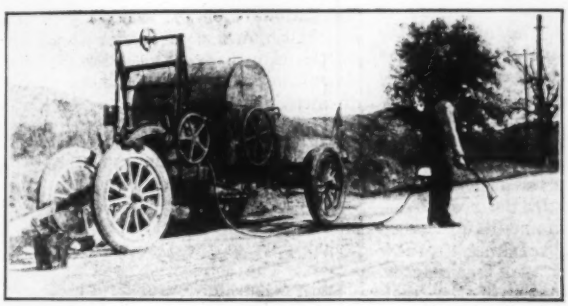
The facts are that freight rates, and passenger fares as well, have never sufficiently, if at all, taken into account the extraordinarily high investment and operating costs in large city terminals. C. F. LOWETH.
Chief Engineer, Chicago, Milwaukee & St. Paul Ry.
Aug. 27

HINTS FOR THE CONTRACTOR

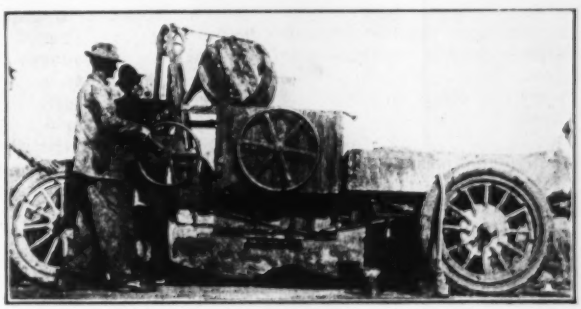
Home-Made Road-Oil Heating Outfit for Small Patching Jobs

CONVENIENT outfits for making road repairs that require comparatively small quantities of hot oil are built in the division repair shops of the California Highway Commission and used wherever the work is not extensive enough to warrant a large road oiler. Mounted on a trailer, with a little space for tools, materials, etc., the outfit is self-contained and can be hauled by motor truck from one point to another. Some divisions use several such devices. While the endeavor is to use standard parts, so that only assembly work is required in building up the units, each division uses whatever can be adapted to this service in the most economical way. The essential features in any of the outfits are an oil tank with heater and hand pump attachments by means of which hot oil is delivered through a hose to a hand spraying nozzle. The more common type consists of a patching outfit mounted on a steel-wheel orchard trailer.

The trailer in the accompanying illustration was made up chiefly with parts salvaged from a wrecked automobile. The chassis was reconstructed with a gooseneck at the front made of 1 x 4-in. iron riveted to the frame. One-inch truss rods and turnbuckles were put on to strengthen the frame; a fifth-wheel was supplied to permit of short-radius turning and to reduce the rocking motion; the new front axle was made of square steel, 2½ in. thick and 3 ft. long, turned to fit.



OUTFIT WITH COVER ON READY FOR SERVICE



LOWERING BARREL OF ASPHALT INTO KETTLE

The oil-handling and heating equipment includes an electrically-welded 130-gal. kettle, rectangular in plan and semicircular in elevation, which rests in a firebox frame of 2-in. angle-iron sheathed with 16-gage sheet iron. The kettle is heated by two kerosene burners which preheat the fuel and then spray it from the burner under a pressure of 15 lb. per square inch. The fuel tank contains 6 gal. and is equipped with hand pump and gage to secure the desired pressure. Inside the kettle a rotary pump is bolted to one end near the bottom. This arrangement, which keeps the pump immersed, avoids the necessity for heating it separately. The pump is operated by a 24-in. handwheel, outside.

The kettle dimensions are such as to accommodate the standard 110-gal. oil drum which is rolled up on skids and into position over the kettle by means of the hand windlass mounted on the trailer frame. While the windlass holds the drum over the kettle the skids are replaced by cradle channels equipped with rollers on which the drum can be turned to replenish the oil in the kettle. These channels are set at a height such that about one-third the diameter of the drum is submerged when the oil in the kettle is at its highest level. A sheet-iron, semi-cylindrical cover fits over kettle and drum to prevent the escape of heat.

Sometimes asphalt which is a solid at ordinary temperature is delivered in wood barrels instead of in the metal drums. The barrels are handled the same as the drums except that the entire contents of a wood barrel is put into the kettle at once. The heads, and ordinarily the wood staves also, are removed before lowering into the kettle. A strainer protects the pump from chips and other foreign matter. The pump delivers to a 16-ft. length of 1-in. armored hose terminating in a pipe about 4 ft. long, encased in wood so the operator can handle it while oil is being delivered at a temperature of about 300 deg. F. Several types of nozzles are used. Any type that delivers a fan-shaped spray and can be controlled by means of a wire running back to a lever on the wooden handle is suitable. The material ordinarily used is asphaltic road oil or grade D or E asphalt.

This outfit cost only $477, because very little special equipment had to be purchased for it. After being in service over eight months, engineers of the highway commission, of which Austin B. Fletcher is chief engineer, report it to be satisfactory.

Records in Shaft Sinking

A mine shaft sunk 310 ft. in 31 days is believed to be the world's record in shaft sinking per month. This was done by the Crown Mines Co., of Johannesburg, South Africa, in July, 1919, but a very close second is 308 ft. in the same time by the Van Dyke Copper Co., of Miami, Ariz., in 1920. The previous record had been 279 ft., by the Crown Mines Co. In May, 1920, on the basis of the Van Dyke shaft work, the *Engineering and Mining Journal* offered a gold medal to the crew which should break the record (see *Engineering News-Record*, June 10, 1920, p. 1174). In its issue of May 21, 1921, the *Engineering and Mining Journal* described in detail the work on the Van Dyke shaft and announced that no higher record had been reported.

NEWS OF THE WEEK

New York, September 15, 1921

Terrific Rainfall Causes Floods in Texas

24-Hr. Fall of 10 to 24 In. in Central Counties, but Worst Damage in San Antonio with 7-In. Fall

RECORD-BREAKING rainfalls throughout central and southern Texas on Sept. 8 to 10 caused floods on practically all the rivers there, with resulting great damage in the smaller streams, particularly at San Antonio, where three creeks run through the business and residential sections. The rainfall is reported to *Engineering News-Record* by B. Bunnemeyer, meteorologist, U. S. Weather Bureau, Houston, as follows:

"The torrential rains in the central area of Texas covered Travis, Williamson, Milam and Bell Counties. Austin reported 18.25 in. for 24 hr. ending 7 a.m., Sept. 10; Taylor, 23.63 in.; Georgetown, 11.30 in.; Cameron, 11.45 in., and Temple, 11 in. Surrounding sections reported much less, San Antonio leading with 3.48 in., but it had 3.36 in. during the preceding 24 hr. ending 7 a.m., Sept. 9. Low places, creeks and smaller streams became rapidly flooded, causing loss of life and great damage to crops, bridges, highways and other property, but the large streams were less seriously affected, due to previous low water and comparatively small areas with excessive rains."

Some confusion exists as to the period in which the maximum rainfall took place. Weather Bureau headquarters at Washington reports it as from "36 to 48 hr." but Fred Morris, observer at Austin, wires, "Total rainfall 3 a.m. Sept. 9 to 3 a.m. Sept. 10 was 19.03 in. Greater part of this fell during last six hours."

San Antonio Flood

From Terrell Bartlett, of Bartlett & Ranney, consulting engineers, San Antonio, the following telegraphic statement of the flood conditions in that city was received on Sept. 13:

"A severe rain falling on the night of Sept. 8 and until midnight Sept. 9 on several watersheds above the city of San Antonio caused unprecedented flood heights in the valley of the San Antonio River and in San Pedro and Alazan Creeks, all three traversing the city. No high winds accompanied the rain. Loss of life does not exceed seventy-five, confined almost entirely to Mexicans resident in the low areas along the creeks. Property damage is estimated at $5,000,000, which includes $500,000 to city pavements and bridges, $3,000,000 to merchandise in flooded basements and first floors, and balance in damaged store windows and frame residences. No modern buildings or structures were injured except one concrete girder bridge across the river, which was wrecked by scour undermining the foundations. Several timber bridges had floors washed away and timber floors on steel truss bridges were misplaced. Two-thirds of the flooded wood block pavements laid in 1914 floated off. Both waterworks pumping plants were flooded, but practically all the city was given continuous low pressure service direct from artesian wells. High pressure was resumed within 36 hr. Lights and street car service were entirely interrupted for 24 hr., but almost fully resumed within two days.

"The rain commenced Thursday night, Sept. 8, and continued at intervals through Friday with heaviest fall north of the city early Friday night. The total for the storm at U. S. Weather Bureau in San Antonio is slightly over 7 in. The average for the 40-square-mile watershed of the San Antonio River and dry tributary Olmus Creek was probably 11 in.

"The flood broke the river banks at the north limits of the city about 10 p.m., flooding Brackenridge Park and the residence districts adjacent and below. About midnight the river overflowed its channel immediately above the business district, reaching its crest in center of the city two hours later. Almost the entire center of the business district was inundated. Water in the river, which winds through the business district, reached a height of 2 to 8 ft. above bridge floors, with a maximum depth of 7 ft. in lobby of one of the leading hotels. It discharged south across Houston St. in seven swift channels at as many streets, besides flowing in the river. The depth at St. Mary's St. was 12 ft. It discharged also to the west for 2,000 ft. north of Houston St. over a low divide into San Pedro Creek. The inundated business district measured two-thirds by one-half mile, the residence district in the river valley one-half by two miles above the center of the city and one-half by three-quarters miles below.

"This flood exceeds all others since Spanish records of 1819, when the town was inundated to 5 ft. greater depth than current flood. As a result of an 8,000 sec.-ft. flood in 1913-14 the city last year had a report prepared on flood prevention. This current flood discharge, about 20,000 sec.-ft. or more, will probably result in prompt construction of channels or reservoirs."

Bridge Accident at Chester Causes 24 Deaths

Sidewalk Bracket Falls Under Weight of Crowd When Cracket Gusset Plate Tears Apart

A crowd massed on the sidewalk of the Third St. bridge over the Chester River at Chester, Pa., on the evening of Sept. 10 to watch attempts at rescuing a boy from the water was thrown into the river by the breaking of a defective sidewalk bracket, and 24 people were drowned. The structure itself, a half-through plate-girder bridge about 70 ft. in span, had its sidewalk supported by 12-ft. brackets cantilevering out from the girders, each bracket being about 3 ft. deep at the inner edge and attached to double stiffener angles of the plate girder by gusset plates at top and bottom. The brackets were spaced about 12 ft. apart. They were made of angle chords with a web system of four panels in the 12-ft. length. The upper attachment gusset of one of these brackets tore apart, allowing the bottom chord of the bracket to bend at its first panel point under the weight of the crowd. As the sidewalk tipped down, some seventy-five persons were thrown into the water.

Gusset Plate Examined

Examination of the ruptured gusset plate of the bracket showed that it had torn off along the outer edge of the plate girder stiffeners, and that the upper part of the fracture was an old crack. The connection was of inferior design, moreover. The gusset was about 15 in. deep and 15 to 18 in. long horizontally, by $\frac{3}{8}$ in. thick. It was riveted to the top chord of the bracket, but bolted, with five bolts, to the girder stiffeners; the corresponding plates of the other brackets, however, were riveted. The upper edge of the plate was flush with the top chord of the bracket, so that the pull was not central. The plate appears to be of wrought iron, moreover, and to have its rolling grain running vertical. The bridge was built by Cofrode & Saylor in 1886, probably with the gusset in question.

For a distance of about 8 in. down from the top, the broken edge of the plate shows by a rusty surface that an old crack existed in the line of the fracture, and that the crack worked downward progressively. It has been suggested that the bracket had been damaged by a colliding vessel a number of years ago, and had been removed for repair, the plate probably being straightened cold without removing it from the bracket angle, and the bracket being then replaced and attached by bolts instead of the original rivets.

Water Rate Increased 20 Per Cent in San Francisco

Railroad Commission Plans Connection Between Spring Valley and Hetch Hetchy Systems

"In order to provide an adequate water supply for San Francisco, pending the completion of the Hetch Hetchy project," the California Railroad Commission, as a part of its decision in the Spring Valley Water Co. rate case, presents a plan for a co-operative agreement between the city and the company under which the company would provide more water and the city would build a portion of the Hetch Hetchy conduit and rent it to the company. The company is allowed a 20-per cent increase in the present water rates, which are the same as they were before the war. Certain expenditures by the company are ordered and terms are prescribed for a possible later purchase of the utility by the city. The joint program answers the city's protest against authorizing the company to make large expenditures that would duplicate work proposed by the city for later construction in completing the Hetch Hetchy project. The co-operative arrangement was to become effective Sept. 1 and to continue until Jan. 1, 1932.

Subsequent to the failure on March 8 of San Francisco voters to approve the purchase of Spring Valley properties (*Engineering News-Record*, March 17, p. 483), the company applied for a 25-per cent rate increase. The railroad commission rules that an increase of 20 per cent is necessary to maintain the company's credit, enable it to carry out certain necessary improvements and provide a fair return on its investment.

Calaveras Reservoir Enlargement

The commission directs the company to enlarge the Calaveras reservoir so as to add 24,000,000 gal. to the present daily supply. The proposed expenditure of $1,500,000 is conditioned on the construction by the city of the section of the proposed Hetch Hetchy conduit from the Niles screen tank on Alameda Creek to Crystal Springs reservoir in San Mateo County. For the use of this conduit the company is to pay the city not more than $250,000 per annum and is to bear all operating expenses during the life of the co-operative arrangement. Under this arrangement the conduit which the city would be required to build can be located so it will be of maximum service in the ultimate completion of the Hetch Hetchy project. Until it is required for that purpose interest on the investment will be covered by the rental which the private company is to pay for its use. The suggestion that joint use of such a conduit might be arranged came from city officials.

To protect the city in case it should buy the Spring Valley system, the commission requires the company to sell to the city during the life of the co-operative plan at the $37,000,000 valuation fixed by the commission in November, 1920, plus additions and betterments. The commission's order also requires the company to create a special fund for the amortization of the Calaveras dam expenditures, this fund to be transferred to the city in the event that the utility's properties are purchased.

San Francisco Bay Bridge Hearing Authorized

A public hearing before representatives of the War Department on the projected bridge across San Francisco Bay has been authorized, according to an announcement made Sept. 3 by Col. Herbert Deakyne, Corps of Engineers, U. S. A., who is stationed at San Francisco. The date for the hearing has been tentatively set for Oct. 7.

In preliminary discussions of the matter Col. Deakyne is quoted as having said that before any plans will be approved they must show provision for "a suitable channel for the free passage of vessels and permit of the free flow of the tides from one part of the day to the other."

Course to Train Personnel for Industrial Publishing

Inauguration on a large scale this fall of a course in industrial publishing, covering the editorial, business and service activities of the field, is announced by the New York Business Publishers Association, Inc., of which "Engineering News-Record" and the other ten engineering papers of the McGraw-Hill Co., are members. The training, which is open to members of the staffs of business and technical publications, as well as to others desiring to engage in this line of work, is designed to develop new personnel and to raise the standards of the industrial publishing business generally.

The entire course will last eight or nine months and will combine home study and weekly class meetings. The Business Training Corp. has been engaged to prepare the educational material for the course and to organize and direct the instruction staff. In this work it will be assisted by a co-operating staff of forty publishers, editors, business managers and service department managers. The instruction staff will be headed by Prof. Henry H. Norris, managing editor of the "Electric Railway Journal" and formerly on the faculty of the department of electrical engineering at Cornell University.

Further details regarding the course may be obtained by addressing The Secretary of the Course in Industrial Publishing, 185 Madison Ave., New York City.

Studies of Chinese Canal Improvement Completed

T. H. Wiggin, American Engineer, Returns to U. S. After Two Years' Work in Orient

After spending two years in China on surveys, reports and estimates for the improvement of the Grand Canal, Thomas H. Wiggin, formerly principal designing engineer of the Catskill aqueduct for the Board of Water Supply of New York City, and lieutenant-colonel of Engineers with the A. E. F. in France during the World War, has returned to this country after completing the preliminary studies for the projected waterway improvement and land reclamation, largely in the Province of Shantung. Further progress in the way of actual construction must await a decision as to the financing of the project, which, it is understood, is now under consideration. The concession for the Chinese work is held by the Siems-Carey Railway & Canal Co., working in co-operation with the American International Corporation. John R. Freeman acted as consulting engineer and Joseph Ripley as chief engineer of the Grand Canal Improvement Board.

Mr. Wiggin left the United States for China in August, 1919, and after Mr. Ripley had returned to this country at the end of the year, Mr. Wiggin assumed his duties as acting chief engineer of the board, with headquarters at Tientsin.

Surveys in Shantung

The bulk of the survey work, according to Mr. Wiggin, was carried on in Shantung and involved about 220 miles of the Grand Canal where it is necessary to modernize existing locks and improve the waterway which had been damaged by floods of the Yellow River and other streams in the province. The engineering staff consisted of a field and office force, consisting principally of Chinese, with an American engineer in charge of each subdivision of the work. To his work with the Grand Canal Improvement Board Mr. Wiggin brought an extensive experience in water supply and hydraulic engineering in this country and in France, where he served two years with the American Expeditionary Forces as chief of the water supply section of the Division of Construction and Forestry, which had general charge of all water-supply projects in the area of the Services of Supply, extending from the base ports to the army zone.

In addition to the preparation of designs for locks and river control works, and various reports and estimates of cost, Mr. Wiggin served in an engineering advisory capacity on two other projects, the first, a water supply for the city of Amoy with a population of about 200,000, and the second an irrigation project for the Province of Shansi, the latter in connection with work of famine prevention. At the instance of Chang Chien, director general of the Grand Canal Bureau of the Province of

Kiangsu, Mr. Wiggin made an inspection and report on canal improvements in that territory.

Pending the financing of the Grand Canal improvement work, the engineering staff which Mr. Wiggin headed has been practically disbanded.

Month's Advance of 591 Ft. Made in Shandaken Tunnel Heading

Excavation of the 18-mile Shandaken tunnel of the Catskill aqueduct, for the additional water supply of New York City, is progressing both north and south from six shafts, and in five of the twelve headings permanent roof support is required. During the month of August, 5,030 lin.ft. of completed tunnel, about 12 ft. wide and 14 ft. high, was excavated, the maximum progress being in the north heading at shaft 3, where 591 lin.ft. was excavated with two drilling and two mucking shifts. The excavation amounts to about 6 cu.yd. per linear foot of tunnel. The average pull per shot in this heading was 10.2 lin.ft. and the average pull per shot for the month throughout the entire tunnel was 8.95 lin.ft.

The tunnel, which is being driven under the direction of the Board of Water Supply of the City of New York, will carry water from the Schoharie River underneath the intervening Catskill Hills into the Ashokan reservoir, within the Esopus watershed, making it thus available for draft through the Catskill aqueduct. Work is being carried on under contract by the Shandaken Tunnel Corp., the active agents being the Ulen Contracting Corp., for which Thomas S. Shepperd is general manager, with headquarters at Allaben, N. Y.

Cave Creek Flood Does Damage at Phoenix

On the night of the 21st of August, a strip of the western portion of Phoenix, Ariz., from 2 to 10 bocks wide, was flooded by water originating in Cave Creek. No lives were lost and the principal damage in the city was to the state capitol, where water stood about 2½ ft. deep on the first floor. Considerable damage was done to private residences. Ranchers living to the north suffered considerable damage to cattle and crops. L. B. Hitchcock, city engineer of Phoenix, describes the development of the flood as follows:

Cave Creek has a drainage area of 200 sq.mi., and from a point about 12 miles north of Phoenix has no defined channel. The waters of average rains spread over a delta and find their way through the Salt River Valley Water Users' Association canals to the Salt and Gila Rivers. In cases of severe rain it has not been unusual for the water to break through the canals and to flood a wide area.

A heavy precipitation occurred on the 19th, which Cave Creek took care of without serious damage. However, in the night of the 20th and early morning of the 21st there was a much heavier precipitation, and, the ground being saturated, an unusually heavy runoff took place. The flood waters broke over the Arizona Canal, which has a flood capacity of 800 sec.-ft., 8 miles from Phoenix and reached their peak 3 p.m. of the 21st with a flow estimated at 25,000 sec.-ft., receding gradually until 5 p.m., when the flow ceased. At 4 p.m. the water overflowed the Grand Canal, which is parallel to and 5 mi. south of the Arizona Canal. This canal has a flood capacity of 600 sec.-ft. The flood reached Phoenix about 7:30, and reached its peak there at 10 p.m., receding by the following morning.

It is estimated that the property damage in Phoenix is $300,000.

The city had voted bonds for $100,000, which was to be supplemented by amounts from the county of Maricopa, the state, the Salt River Valley Water Users' Association and other interests, to an aggregate of $400,000, for protection against Cave Creek floods. The work had not been begun, pending completion of financial arrangements.

Fix Height of Rimrock Dam

The exact height of the Teiton dam at Rimrock, near Yakima, Wash., has been determined. The recent conference of government engineers, it is reported, decided that excavations for the corewall underneath the stream bed had reached bed rock firm enough to be tied into and concrete is being poured now 95 ft. below the bed of the river. The crest of the dam will be 222 ft. above the bed of the river, making the distance from the bottom of the corewall to the crest of the dam about 317 ft.

High Rate of Progress Made in Hetch Hetchy Tunnel

A heading advance of 776 ft. in a month was accomplished during August at Priest Portal heading of the Hetch Hetchy aqueduct tunnel of the new San Francisco water supply. The heading passed through altered slate and schist. Eight headings are being worked, and their advance during August ranged from 273 ft. to the Priest figure; the average for the eight was 436 ft. The Construction Co. of North America, contractor, gives the record of the month's work in the table above.

HETCH HETCHY TUNNEL PROGRESS FOR AUGUST, 1921

Heading	Tunnel Section Ft.	In.	Rock	Holes per Round	Superintendent	Shifts Worked	Progress During Month, Feet	Total Progress to Date, Feet
Intake	13	8	Monolithic granite	45 / 48	Johnson	62	273	7,179
South Fork E.	13	8	Monolithic granite	45	Seterson	62	424	7,929
South Fork W.	13	8	Monolithic granite	48	Seterson	62	477	2,795
Adit 5-6 E.	13	8	Granodiorite	38	Gallagher	62	300	1,017
Adit 5-6 W.	13	8	Diorite	34	Gallagher	93	436	1,070
Big Creek E.	11	3	Diorite	25	owler	62	414	3,125
Big Creek W.	11	3	Diorite	25	l owler	62	420	4,117
Priest	11	3	Altered slate and schist	25	Hickman	93	776	11,130
							3,490	37,453

Port Problems Discussed by Civil Engineers

The three-session meeting on "National Port Problems" of the American Society of Civil Engineers was held according to schedule in New York on Sept. 7 and 8. The papers announced in the advance notice reprinted in this journal, Sept. 1, p. 380, were all delivered. Many of them were excellent expositions of certain phases of the port problem. Viewed as an economic and political question, but little of constructive value developed. The discussion was perfunctory.

The following resolution, offered by Col. W. J. Wilgus, was passed:

"Resolved: That it is the sense of this meeting that the proper future planning of our seaports is of national concern from the standpoints both of commerce and of military protection, and that the Board of Direction be requested to urge upon the Secretary of War, if possible in co-operation with the other national engineering societies, the need for prompt and effective action to that end, under the provisions of Section 500 of the Transportation Act of 1920."

All Cross-Connections at Hartford To Go by Jan. 1

An extension of time to Jan. 1, 1922, for the severance of all cross-connections between the water-works of Hartford, Conn., and private supplies for industrial and fire protection purposes has been granted by the Board of Water Commissioners. (See abstract of report by the George W. Goethals Corp. p. 409 of last week's issue.) It is understood that the manufacturers will now co-operate in abolishing the remaining cross-connections with polluted supplies, of which there were originally 13 protected by double check valves. C. M. Saville is engineer and manager of the Hartford Water Board.

Road Materials Survey to be Made in Colorado

By co-operation between the Colorado State Highway Commission and the State Agricultural College a survey is to be made of road materials. Deposits suitable for road making are to be located and mapped as to extent. Samples will be collected and sent to the road materials laboratory of the college.

Two Bids for Boston Garbage and Refuse Disposal

Two bids were received Sept. 7 for the disposal of the garbage and refuse of Boston for the ten years beginning July 1, 1922. The Boston Development & Sanitary Co., the present contractor for this work, made a total bid of $4,202,000, based on a yearly price declining from $436,000 a year at the start to $402,000 for the last full year and a rate of $400,000 a year for the final half year. Coleman Bros., Inc., bid a total of $3,795,000 at a uniform yearly rate, but with deductions from this price ranging from $350,000 to $745,000 if some one of four modifications of the basic bid were adopted. These deductions were: $350,000 if allowed to establish a hog farm on Spectacle Island where the disposal plant is located; $100,000 if the city purchases the present disposal plant, belonging to the Boston Development & Sanitary Co. (the other bidder); $450,000 if both the first two modifications were permitted, and $745,000 if the city would allow the garbage of Dorchester, the South end and Charlestown to be received at railroad sidings located in those districts and shipped to outlying sections for sale to farmers as hog food.

A report on the bids will be made by Thomas F. Sullivan, commissioner of public works, for final action by the city council in the award of the contract.

The specifications under which the bids were received were drafted by a special garbage committee appointed by the mayor. Dr. W. C. Woodward, health commissioner of Boston, was chairman of the committee. The contract price for the 10-year period ending July 1, 1922, is $1,402,000, on a sliding scale which makes the price for the present year $156,000 and for the final half year at the rate of $160,000 a year.

Complete Reconstruction of Tehachapi Tunnels

The Southern Pacific R.R. has just completed the 5-year job of enlarging and lining with concrete the tunnels on its line over the Tehachapi mountains in California. The cost of the work in these tunnels has been about $1,000,000 and it has been carried out without delay to trains, despite the fact that the 48 miles of track between Bakersfield and Tehachapi, according to Southern Pacific officials, is the busiest single-track line in the United States. This track serves as a main trunk line for both the Southern Pacific and the Santa Fe systems.

Prior to 1916 the eighteen tunnels on the Tehachapi grade were all of small bore and were lined with timber, except for about 1,000 ft. which was in solid rock. It was then decided that repair and enlargement were necessary and concrete lined tunnels with a minimum width of 16 ft. on tangent and 17 ft. on curves and an overhead clearance of 22 ft. were decided upon. In the reconstruction two of the tunnels were eliminated by relocation, and the others have been enlarged and concreted by methods described in *Engineering News-Record* July 28, p. 134.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Valparaiso, Ind.; Annual Convention, Baltimore, Md., Oct. 24-28.

CITY MANAGERS ASSOCIATION, Spartanburg, S. C.; Annual Meeting, Chicago, Nov. 14-16.

NATIONAL MUNICIPAL LEAGUE, New York City; Annual Meeting, Chicago, Nov. 16-18.

The Engineering Society of Western Massachusetts, Springfield, will hold an inspection Sept. 13, of the new highway bridge now being built for the County of Hampden across the Connecticut River between Springfield and West Springfield.

The Wisconsin State Drainage Association will hold its summer meeting in St. Paul, Minn., Sept. 22-24.

The Technical Club of Dallas (Tex.), at its meeting Aug. 29 which was adressed by Dr. J. F. Kimball, superintendent of the Dallas Schools, indorsed the "Go to School Movement" and indicated its interest in civic affairs by offering to assist the Junior Chamber of Commerce to put Dallas in the lead in scholastic attendance.

Personal Notes

C. C. COTTRELL has resigned as state highway engineer of Nevada to become manager of the good roads bureau of the California State Automobile Association. After attending the University of Nebraska for 2½ years he became assistant to the Surveyor of Nemaha County, Neb., in 1904 and from that time on engaged in road and irrigation work in the West From 1913 to 1917 he was superintendent of construction and maintenance on the San Francisco division of the California Highway Commission. He went to Nevada as assistant state highway engineer in 1917 and the following year became state highway engineer.

GEORGE W. BORDEN, assistant state highway engineer of Nevada, has been named acting state highway engineer, following the resignation of C. C. Cottrell.

C. V. CONNER, formerly designing engineering inspector with the Delaware State Highway Department, has been appointed assistant engineer with the North Carolina Highway Commission on the design and general field inspection of bridges and hard surface pavements.

H. C. LEE, formerly connected with the engineering departments of the Philadelphia & Reading Ry. and the American Bridge Co., will, after visiting some of the engineering structures in the United States and Canada, return to China, his native country, to become connected with the Chinese Government Rys.

T. J. WYCHE, formerly chief engineer, Western Pacific R.R., has been appointed consulting engineer, with headquarters in San Francisco.

ARTHUR H. NILES, formerly assistant city engineer of Jackson, Mich., has been appointed city engineer of Sturgis, Mich.

GEORGE W. BURPEE, formerly managing engineer, Westinghouse, Church, Kerr & Co., and since the merger of that company with Dwight P. Robinson & Co., managing engineer of the latter, has severed his connection with the Robinson organization and has joined the staff of Coverdale & Colpitts, consulting engineers, of New York, specializing in engineering investigations and reports.

G. M. BRAUNE, professor of civil engineering, University of Cincinnati, has resigned to become head of the civil engineering department of the University of North Carolina. He has been connected with the University of Cincinnati since 1912. For 5 years he was engineer with the Southern Bridge Co., Birmingham, Ala., and was later connected with the New York State Barge Canal, part of this time as assistant chief bridge designer.

B. E. CLARK, acting state engineer and also acting state highway commissioner of Oklahoma, has been appointed state highway commissioner.

LOUIS A. GUEPEL has been appointed sanitary engineer in charge of the Indiana state water and sewage laboratories, succeeding John C. Diggs, who has been transferred to the State Conservation Department.

A. L. LUEDKE, engineer-economist, U. S. Bureau of Public Roads, Washington, D. C. and formerly assistant to the director of the bureau, has been transferred to St. Paul, Minn. (district 4) reporting to E. O. Hathaway, district engineer.

H. G. SHULDE, formerly acting district engineer, district 18, Pennsylvania State Highway Department, with headquarters at Bedford, Pa., has been appointed district engineer, with headquarters at Sunbury, Pa., of district 3, which includes the counties of Columbia, Montour, Northumberland. Sullivan, Snyder and Union.

COL. WILLIAM BARCLAY PARSONS, consulting engineer, New York City, who was in command of the Eleventh Engineers in France during the latter part of the World War, has been assigned the command of a service engineers' regiment in organ-

ized reserves of the Second Corps Area with headquarters at Governors Island, comprising the States of New York, New Jersey and Delaware.

PAUL BAILEY has been made chief deputy to W. F. McClure, state engineer of California. Mr. Bailey has been in the engineering department of the state water commission for a number of years and under the recent reorganization was made assistant chief of the division of water rights of the state department of public works. In his present position he will still be in the department of public works, as the state engineer's office is now a branch of that department.

G. H. HICKS has been appointed acting chief engineer of the Northwestern Pacific R. R., succeeding J. W. Williams who recently resigned to become chief engineer of the Western Pacific R. R. He has been in the employ of the Northwestern Pacific since 1912, and since September, 1919 has been principal assistant engineer.

U. S. STEPHENS has been appointed county engineer and road superintendent, Runnels County, Tex., to have charge of all road work.

F. A. JONES, formerly supervisor of track, sub-division 1, Boston & Albany R.R., with headquarters at South Station, Boston, has been appointed assistant supervisor of bridges and buildings, Albany division, with headquarters at Springfield, Mass.

V. H. CARTER, formerly chief designing engineer, has been appointed acting harbor engineer in charge of port development, maintenance and reclamation for the Port of Oakland, California.

WILLIAM L. REEVES, formerly a city commissioner of Pasadena, Cal., has been appointed city manager of Glendale, Cal.

OBITUARY

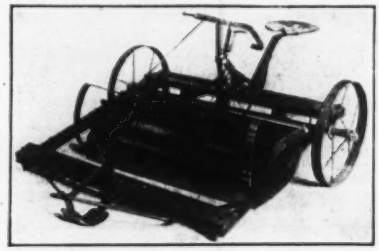
JOHN MCMULLEN, president, until February of this year, of the Atlantic Gulf & Pacific Co., and founder of that organization, died in South Norwalk, Conn., Sept. 29, at the age of 73. He organized the San Francisco Bridge Co. and the Puget Sound Bridge & Dredging Co., which were combined in 1899 to form the Atlantic Gulf & Pacific organization. Mr. McMullen was a graduate of St. Charles College, Baltimore, Md., and his early work was in the general contracting field.

CHARLES R. LARKIN, assistant engineer, Bureau of Health, Philadelphia, Pa., died Aug. 30. He was born in Philadelphia in 1881 and received the degree of B.S. and C.E., Villanova College, in 1914. From 1914 to 1916 he was highway engineer with the Union Paving Co., Philadelphia, and since 1916 has been with the Bureau of Health.

NEW EQUIPMENT AND MATERIALS

New Wheel Scraper

A wheel scraper, with a body resembling a Fresno in shape and action, is being built by the Miskin Scraper Works, Ucon, Idaho. This scraper is made in several sizes for operation by two, three or four-horse teams or by

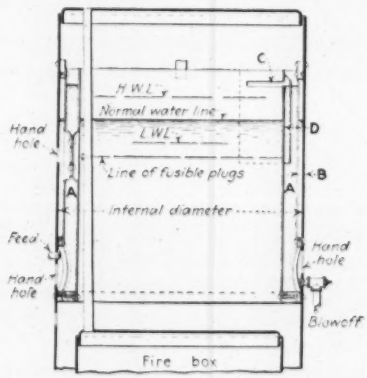


tractors. It is dumped by a foot trip and can be adjusted to discharge the load in a pile or to spread it in a thin layer. Being without a tongue it can be turned in a short radius. While developed particularly for grading land for irrigation the new scraper has been employed successfully for nearly two years on road work in Bingham County, Idaho.

Scale-Proof Crane Boiler

What is termed a scale-proof locomotive-crane boiler, equipped with an annular scale chamber placed between the tubes and the shell plate of the boiler, is being manufactured by the Industrial Works of Bay City, Mich., builders of "Industrial" locomotives and cranes.

In the new boiler, feed water is slowly



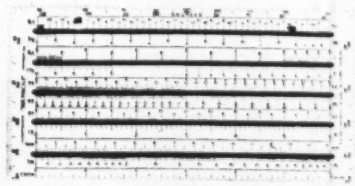
passed through this scale chamber at about 1/200 of the speed through the intake pipe, and attains a temperature at which the scale-forming impurities will be liberated from solution without the use of any chemicals. As the movement of the water is very slow, the precipitates settle to the bottom of the chamber.

The purifier consists of the annular scale chamber *A* with a 1-in. water space *B* between this chamber and the boiler shell. The outlet into the boiler is the slot *C* guarded by the apron *D*. The feed water reaches approximately the boiler temperature before overflowing. The apron keeps out any floating impurities.

Similar types of boilers have been used on steam shovels, dredges, etc., and have proved their value because of their ability to utilize all kinds of feed water.

Eighteen Scales and Protractor in One

Eighteen scales and a protractor are placed on one 3¾ x 7¼-in. celluloid sheet in the Multo-Scale, which is being put on the market by the Cellu-Technic Co., of Palisades Park, N. J. Each scale has its own edge, the sheet being perforated with five slots, as shown in the illustration. The scales are each 6 in. long and include architect scales of ¼, ⅜, ½, ¾, 1½ and 3 in. to the foot. The engineer scales are 10, 20, 30, 40, 50, 25 and 60 parts to the inch. There are in addition a metric scale, a logarith-



THE HEAVY BLACK LINES INDICATE THE SLOTS IN THE INSTRUMENTS

metic scale (for graphic work), and a scale graduated in thirty seconds. A 180-deg. protractor runs around the edge of the sheet.

The material used for the scale is called Prismatex, a grade of celluloid, and has the bottom side especially prepared to accomplish optically what ground glass does in a camera, gives a white background for the black graduations, even when used on blueprints and vandykes.

The scale comes in a leather case.

Out-of-the-Ordinary Trade Publications

Contractors whose operations demand extensive excavation, as well as quarrymen, will be interested in a recent booklet issued by the SANDERSON CYCLONE DRILL CO., Orrville, Ohio, which explains in detail the use of Cyclone drills for big blast-hole drilling. Contractors have usually been content with benching, tripod drilling, and coyote hole methods. However, the process of using a glorified well drill for drilling blast holes is fully explained in the booklet. Full details as to the comparison of big-hole blasting with the more common methods are given. Aside from being a publication which has for its prime purpose the exploitation of the Sanderson cyclone drill products, the booklet is a good commentary on drilling operations of all kinds.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Chicago Building Trades Wages Reduced

Judge Landis Makes Cuts of 10 to 30 Per Cent and Abrogates Restrictive Working Conditions

Judge Landis, as sole umpire in the building-trades wages controversy in Chicago, handed down his decision Sept. 7. Skilled wages in Chicago had been $1.25 per hour, wages for common labor and helpers, $1, and for excavating labor, 75 cents. These rates are reduced from 10 to 33 per cent, as shown in the following table. In addition, Judge Landis brought about the acceptance of a new standard agreement by most of the trades, doing away with restrictive working conditions. The following are the features of the new agreements:

Disputes are to be adjusted peacefully, subject to appeal to the National Board of Jurisdictional Awards; there is to be no stoppage of work individually or collectively under penalties described, except when an owner attempts to construct a building with non-union men while putting up another building on which union men are employed, and when the employer fails to pay employees for work done; in case of scarcity of help non-union men may work with union men until such time as union men may be obtained; any journeyman may use in his work the tools of any other trade; small tasks of not over 30 min. duration in any one day, belonging to any trade, may be performed by any other trade at the discretion of the employer; overtime work during the first 2½ hr. beyond a regular working day to be paid at one and a half times the regular wage; overtime work beyond this and work on Saturday afternoons, Sundays, and holidays to be paid at double rates; shift work to be paid at the regular day rate; contractors not affiliated with the employers' associations may avail themselves of all the benefits by joining the associations, and the union will provide them with men the same as members of the association; there shall be no restriction as to the amount of work a man may do, nor against the use of machinery, methods, or appliances, nor against any raw or manufactured material except prison made; employers may employ or discharge whomsoever of the union they please, and employees may work for whomsoever they see fit, and the foreman, if any, is to be exclusively the agent of the employer.

The wage awards made by Judge Landis are tabulated in the adjoining column, rates being per hour.

Five unions—the carpenters, elevator constructors, plasterers, sheet metal workers, painters, glaziers, and fixture hangers—were not signatories to the arbitration agreement. The following tentative awards were made by Judge Landis if at any time before Nov. 1, 1922, these unions wish to enter the agreement under certain specifications laid down in the award text.

	—Per Hour— New Wage	Old Wage
Carpenters	$1 00	$1 25
Plasterers	1 10	1 25
Elevator constructors	0 95	1 25
Sheet metal workers	0 95	1 25
Painters	0 95	1 25
Glaziers	0 95	1 25
Fixture hangers	1 00	1 25

WAGE AWARDS IN BUILDING TRADES

Trade—	New Wage	Old Wage
Plumbers	$0 95	$1 25
Brick layers	1 10	1 25
Boiler makers	1 00	1 25
Steamfitters	0 95	1 25
Hoisting engineers (for operation of high pressure boilers and engines, cable ways, derricks, pile drivers, cranes and cable hoists)	1 10	1 25
Hoisting engineers (all others)	0 85	1 25
Tile layers (fire proofers)	1 12½	1 25
Cement finishers	0 85	1 25
Composition floor finishers	0 97½	1 25
Cement workers, laborers	0 72½	1 00
Stone derrickmen	0 90	1 25
Drain layers	0 82½	1 25
Electricians	1 10	1 25
Gasfitters	0 95	1 25
Ornamental ironworkers	0 95	1 25
Structural ironworkers	1 05	1 25
Common laborers	0 72½	1 00
Caisson men (windlass and niggerhead men)	0 85	1 00
Caisson men (diggers and laggers)	0 97½	1 00
laborers (plasterers)	0 78½	1 00
Excavating labor	0 47½	0 75
Excavating labor (wall men)	0 55	0 75
Composition floor laborers	0 72½	1 00
Lathers	1 00	1 25
Machinery movers and riggers	0 85	1 25
Marble setters	0 87½	1 25
Marble setters' helpers	0 70	1 00
Marble rubbers and polishers	0 75	1 00
Scagliola rubbers and polishers	0 75	1 00
Mosaic and tile workers	1 02½	1 25
Mosaic and tile helpers	0 70	1 00
Pipe and boiler coverers	0 95	1 25
Composition roofers	0 92½	1 25
Slate and tile roofers	1 00	1 25
Stone cutters	1 02½	1 25
Stone carvers	1 25	1 25
Stone planer men	0 82½	1 25
Terrazo mechanics	0 95	1 25
Terrazo mechanics' assistant	0 80	1 00
Terrazo helpers	0 70	1 00
Tuck pointers	1 00	1 25
Sprinkler fitters	0 92½	1 25
Sprinkler fitters' helpers	0 70	1 00
	—Per Week— New Wage	Old Wage
Composition roofers' teamsters	$30 00	$45 00

Navy Cuts Wages

The Navy Department, after inquiry by a board appointed by the Secretary, has reduced wages ranging from 13 to 14 per cent for all classes of labor. Common labor is reduced to 41c. per hour and skilled labor is lowered to 73c.

Calling attention to the fact that the cost of living, according to the Department of Labor figures, has gone down 16.7 per cent, the investigating board pointed out that the general decrease in wages throughout the country within the last year has been 18.5 per cent; on the railroads, 10 per cent, and in steel plants, 25 per cent.

It gives the average rate of pay in the building trades as 80c. per hour and in the automobile industry as 77c.

Tile Manufacturers Indicted

On charges of criminal violation of the Sherman anti-trust law, the Federal Grand Jury at New York City last week returned indictments against thirty corporations, thirty-two firms, and thirty-two individuals, manufacturers of building tile and members of the Atlantic Coast District Tile, Grate & Mantel Association. The defendants are charged, on five counts, with conspiracy to eliminate competition, to control prices, and to restrain trade by agreements not to sell tile to general contractors and builders. It is alleged, also, that an agreement existed between the tile manufacturers and an "organization of labor" which prevented non-members of the employers organization from obtaining labor.

United States Attorney William Hayward is quoted as saying: "The fact that labor organizations have not been included in this indictment must not be regarded as signifying that labor organizations which have violated the law will be immune from as vigorous prosecution as those indicted will receive." It is promised that investigation of labor's connection with illegal practices in the building trades will continue, and, where evidence of guilt is found, indictments and prosecution will follow. The indictment of the tile manufacturers is based upon testimony collected by the Lockwood Committee.

Among the methods adopted to stifle competition, according to Col. Hayward, was the "K. O. system" under which, in the case of certain general contractors, tile manufacturer in a position to bid received instructions to "Keep Off," leaving the field to one concern. In such cases accommodation bids all higher than that of the favored manufacturer, were submitted. It is also stated that the manufacturers maintained a black list of builders refusing to pay claims for extra work.

The Government, it is understood, will be ready to go to trial on Sept. 20, the date set for pleading to the indictments.

Unfair Competition Is Charge Against Gypsum Makers

Complaint of unfair competition has been made by the Federal Trade Commission against the Gypsum Industries Association of Chicago, seven of its executive officers and 24 members in various states. It is claimed that association members endeavored to eliminate mail order competition by restricting sales to dealers with retail establishments and by limiting each member's sales to the territory reached by delivery trucks of retailers to whom he sells. Dealers who sell by mail orders or otherwise are excluded, the complaint alleges.

dealers maintain retail establishments are excluded, the complaint further alleges.

Approves Freight Rate Cut on Sand, Gravel and Stone

The Interstate Commerce Commission, Sept. 10, approved applications of carriers in eastern trunk-line territory for authority to make heavy reductions on five-days' notice in rates on sand, gravel and crushed stone applicable upon interstate traffic between practically all points in trunk line territory, including Pennsylvania, New Jersey, Delaware, Maryland and portions of West Virginia and Virginia. The new rates are to be published to become effective Oct. 1 and constitute material reductions under the rates now in effect. The basis to be employed in constructing the new rates is 15 per cent higher than the rates in effect prior to the general increase of August, 1920, thus substituting a 15 per cent increase for a 40 per cent increase.

A large volume of movement of these commodities for roads, buildings and other construction work will be affected and it is expected that the annual reduction in transportation charges will be much in excess of a million dollars.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of September 1, the next on October 6.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb	$2.88	+$4.00	$4.01	$2.88	$3.16	$4.00	$3.70	−$3.75	−$4.00
Structural rivets, 100 lb	3.70	5.25	5.50	3.68	4.15	4.25	5.50	−5.00	−6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.78	+3.25	3.50	2.78	3.18	3.57½	2.35	3.75	3.75
Steel pipe, black, 3½ to 6 in. lap, discount	51%	52 65-5%	45%	48½%	53 9-5%	36%	46.25%	48½%	5%
Cast-iron pipe, 6 in. and over, ton	43.30	−40.50	53.30	45.60	50.80	−52.00	60.00	60.00	70.00
Concreting Material:									
Cement without bags, bbl.	2.60@2.70(del.)	−2.69	2.80	2.17	2.41	3.10	3.09	3.10	3.10
Gravel, ¾ in., cu.yd	2.25	−2.13	3.00	1.80	2.00	2.50	2.25	1.50	1.50
Sand, cu.yd	1.25	1.35	2.50	1.80	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.80 to 1.90	2.25	2.80	2.00	2.25	3.50	2.25	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	45.00	−35.00	35.00	46.00	34.00	49.00	30.00	21.00	120.00
Lime, finishing, hydrated, ton	16.99	19.00	25.00	20.00	29.00	30.00	25.40	24.00	21.00
Lime common, lump, per bbl.	3.69	+1.60	2.75	1.65	1.50	2.95	2.25	2.75	15.00
Common brick, delivered, 1,000	18.40@19.40	10.00	12.72	11.00	17.00	14.00	18.00	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.14	.124	.0926	.092	.09	.12½	.11	.15
Hollow partition tile 4x12x12, block	.11370	.14	.124	.07410	.092	.10	.14½	.12	....
Linseed oil, raw, 5 bbl. lots, gal.	.78	−.84	.98	−.84	−.86	.98	−.91	.79	.86
Common Labor:									
Common labor, union, hour	.75@.80	.35	.....	−.72½	.50	.50 @.63½	.81¼	.75	....
Common labor, non-union, hour	.....	.20	.35@.45	−.35	.50	.37½@.50	.50@.55	.50	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45@50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted along side dock. **Chicago** quotes hydrated lime in 50-lb. bags. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.60 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime; white is $1.80 for Kelly Island and $1.65 for Sheboygan. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. **Dallas** quotes lime per 180-lb. bbl. Steel, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Cement price is in Canadian funds exchange with the United States being 14 per cent at present. Bag change is 80c per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment

Changes Since Last Week

Although quotations as low as $1.70 have been made on structural steel shapes, the Pittsburgh price of $1.75@$1.80 per 100 lb. has prevailed throughout the week. Pittsburgh prices on reinforcing bars and quotations on mill shipments, New York, of structural shapes have remained unchanged. Mill shipments, New York, of steel bars are quoted at $2.03 as against $2.08 per 100 lb. Dallas quotes mill shipments of reinforcing bars at $3.05 per 100 lb. Mill shipment prices in Minneapolis of structural steel remain at $2.45 for lake and rail and $2.51 for all rail shipments. These prices represent the Pittsburgh base price plus 60c. for lake and rail and 66c. per 100 lb. for all rail shipments. Seattle quotes steel shapes at $3.75 as against $4, and structural rivets at $5, as compared with $5.25 per 100 lb. previously.

Declines in cast-iron pipe are reported in two cities. In Atlanta the price has dropped from $43.33 to $40.50, and in Denver from $57.50 to $52 per ton.

Atlanta reports slight declines in cement and gravel prices. The market on sand, gravel and hollow tile is very unsettled and there has been much cutting under in order to meet competition; there is better feeling, however, since the recent advance in cotton.

Long leaf yellow pine has dropped $3 in Atlanta and Douglas fir has declined 50c. per M. ft. in Seattle.

Atlanta reports an advance of 10c. in common lump lime, making the present price $1.60 as against $1.50 per bbl.

Decreases ranging from 2c. to 4c. per gal. in linseed oil are shown throughout the country. Reports from Minneapolis state that the flax market has moved up and that linseed oil manufacturers predict an advance in price, if the flax quotations hold firmly.

Slight increase in employment in the building trades is evident in Denver; while San Francisco reports building operations going ahead rapidly, and that men are being put to work as soon as they can be used to advantage. The recent decision in Chicago places the wage rate for bricklayers at $1.10, carpenters $1, structural iron workers $1.05, common labor, union, 72½c., and common labor, non-union, 35c. per hr. Hoisting engineers for operation of high pressure boilers and engines, cable ways, derricks, pile drivers, cranes and cable hoists, receive $1.10; all others 85c. per hour.